US009450323B2

(12) **United States Patent**
Ohkubo et al.

(10) **Patent No.: US 9,450,323 B2**
(45) **Date of Patent: Sep. 20, 2016**

(54) **TERMINAL FITTING CONNECTION STRUCTURE AND ROTARY FITTING-TYPE CONNECTOR**

(71) Applicant: **Yazaki Corporation**, Tokyo (JP)

(72) Inventors: **Yoshitaka Ohkubo**, Kakegawa (JP); **Hiroaki Imai**, Kakegawa (JP)

(73) Assignee: **YAZAKI CORPORATION**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/960,850**

(22) Filed: **Dec. 7, 2015**

(65) **Prior Publication Data**

US 2016/0087365 A1 Mar. 24, 2016

Related U.S. Application Data

(63) Continuation of application No. PCT/JP2014/067675, filed on Jul. 2, 2014.

(30) **Foreign Application Priority Data**

Jul. 2, 2013 (JP) 2013-139097

(51) **Int. Cl.**

H01R 13/28	(2006.01)
H01R 13/42	(2006.01)
H01R 4/48	(2006.01)
H01R 35/04	(2006.01)
H01R 24/00	(2011.01)
H01R 13/627	(2006.01)
H01R 101/00	(2006.01)

(52) **U.S. Cl.**

CPC ***H01R 13/42*** (2013.01); ***H01R 4/48*** (2013.01); ***H01R 24/005*** (2013.01); ***H01R 35/04*** (2013.01); *H01R 13/6278* (2013.01); *H01R 2101/00* (2013.01)

(58) **Field of Classification Search**

CPC H01R 13/28; H01R 13/20; H01R 13/213; H01R 13/22; H01R 13/625; H01R 2101/00

USPC 439/288–290, 332, 333

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,431,580 A		7/1995	Tabata	
5,529,509 A	*	6/1996	Hayes	H01R 11/12 439/288

(Continued)

FOREIGN PATENT DOCUMENTS

EP	2065982 A1	6/2009
JP	S51 68389	5/1976
JP	S57 179274	11/1982
JP	H6 295760 A	10/1994
JP	H9 232019 A	9/1997
JP	2000 277197 A	10/2000
JP	2011 228061 A	11/2011

OTHER PUBLICATIONS

Translation of International Preliminary Report on Patentabilitydated Jan. 14, 2016, issued by the International Searching Authority in counterpart International Application No. PCT/JP2014/067675 (PCT/IB/338, PCT/IB/373 & PCT/ISA/237).

International Search Report (PCT/ISA/210, 220, 237) dated Sep. 22, 2014, issued by the International Searching Authority in counterpart International Application No. PCT/JP2014/067675.

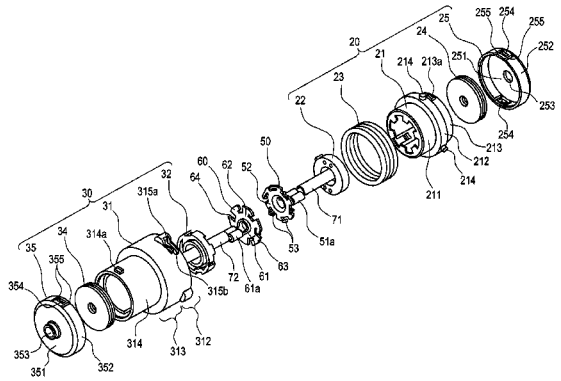
Primary Examiner — Hien Vu

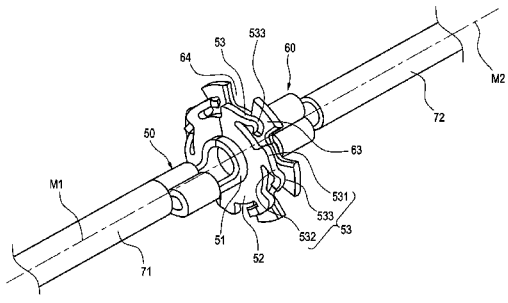
(74) *Attorney, Agent, or Firm* — Sughrue Mion, PLLC

(57) **ABSTRACT**

A second terminal fitting which abuts and is connected to a first terminal fitting includes a second annular portion formed at the tip end of a second terminal body which extends on a center axis thereof, a plurality of contact surfaces which protrude from the outer periphery of the second annular portion at the same intervals as those of a plurality of contact protrusions in the first terminal fitting, and a plurality of contact release portions which are positioned between the adjacent contact surfaces.

5 Claims, 21 Drawing Sheets





(56) **References Cited**

U.S. PATENT DOCUMENTS

5,558,531	A *	9/1996	Ikeda	H01R 13/28 439/287
5,759,056	A *	6/1998	Costello	H01R 11/12 439/290
5,834,696	A	11/1998	Kurosawa et al.	
5,865,638	A *	2/1999	Trafton	H01R 11/12 439/288
6,409,531	B1 *	6/2002	Millard	H01R 13/22 439/289

* cited by examiner

Fig. 1

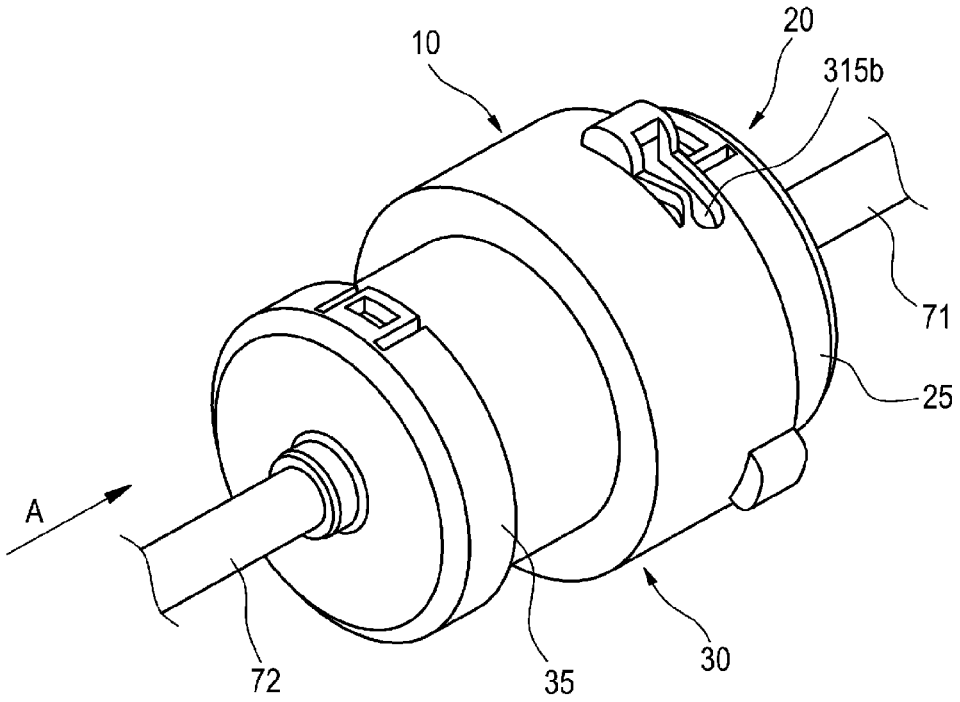
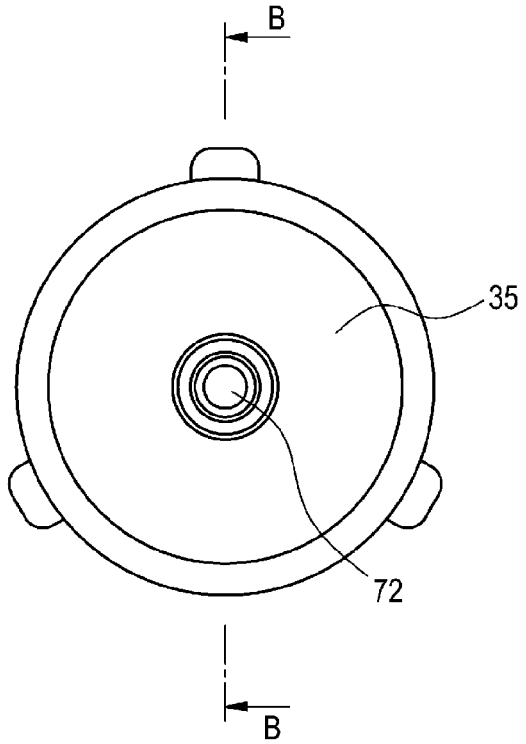


Fig. 2



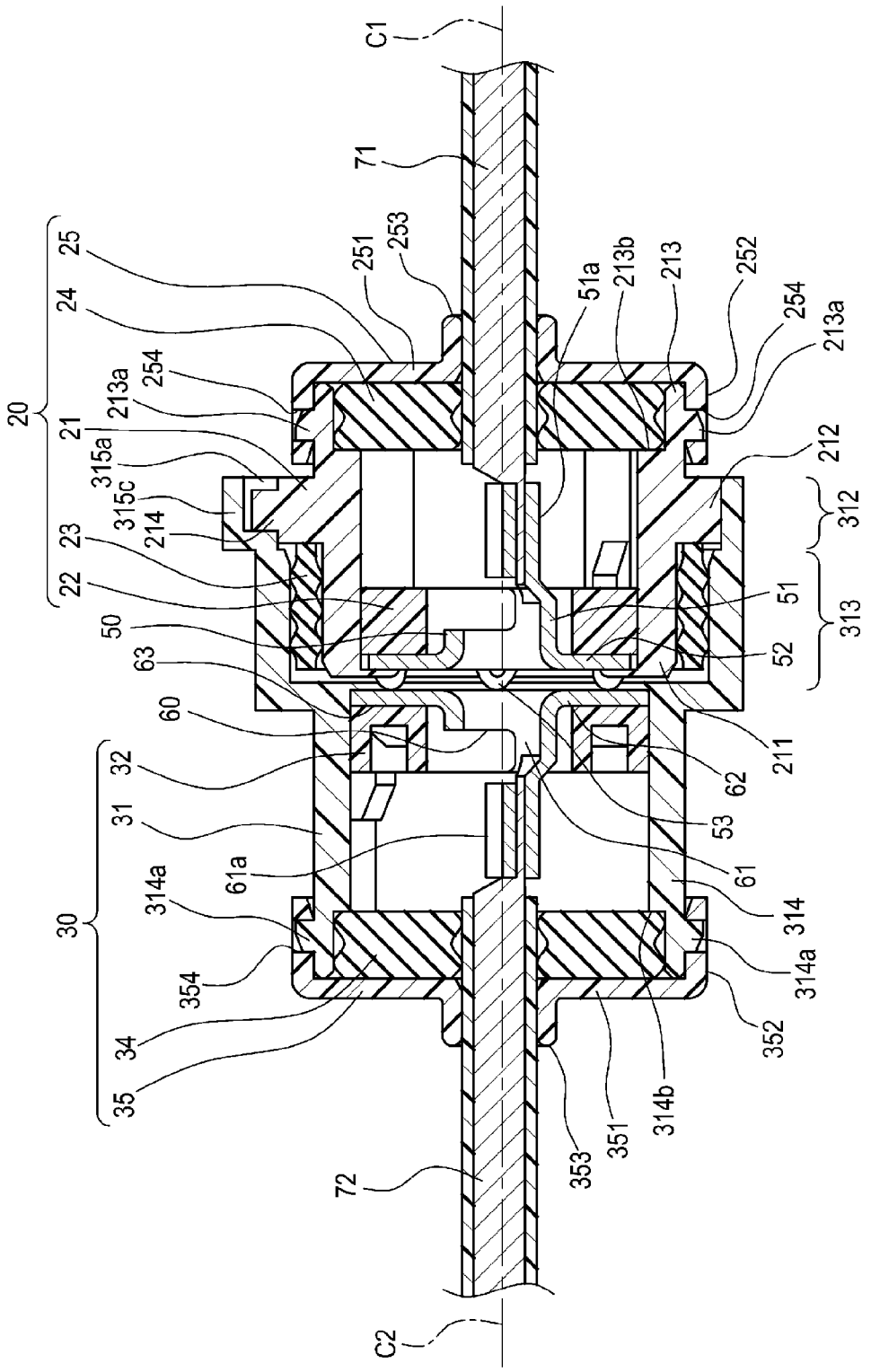

C1
71
251
253
25
24
20
21
254
213a
315a
315c
214
23
22
50
63
60
32
31
61a
314a
30
354
34
35
72
C2
51a
213b
213
252
254
213a
212
312
51
313
52
211
62
53
61
314
314a
352
314b
351
353

Fig. 3

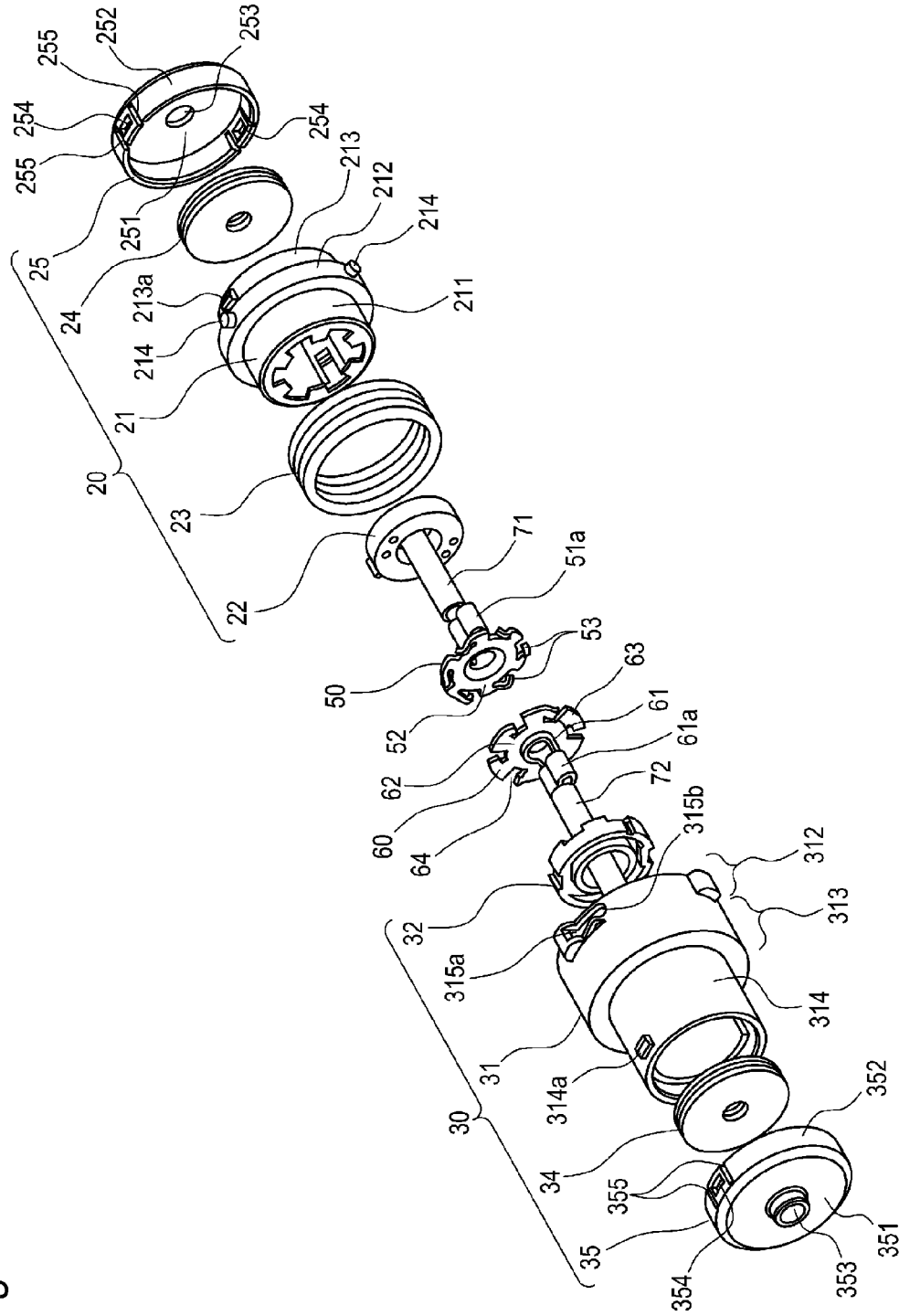

255
252
253
254
255
254
213
212
214
251
25
24
213a
214
211
21
20
23
22
71
51a
53
50
52
63
61
61a
62
72
60
64
315b
312
313
32
315a
314
31
314a
352
30
34
355
35
354
353
351

Fig. 4

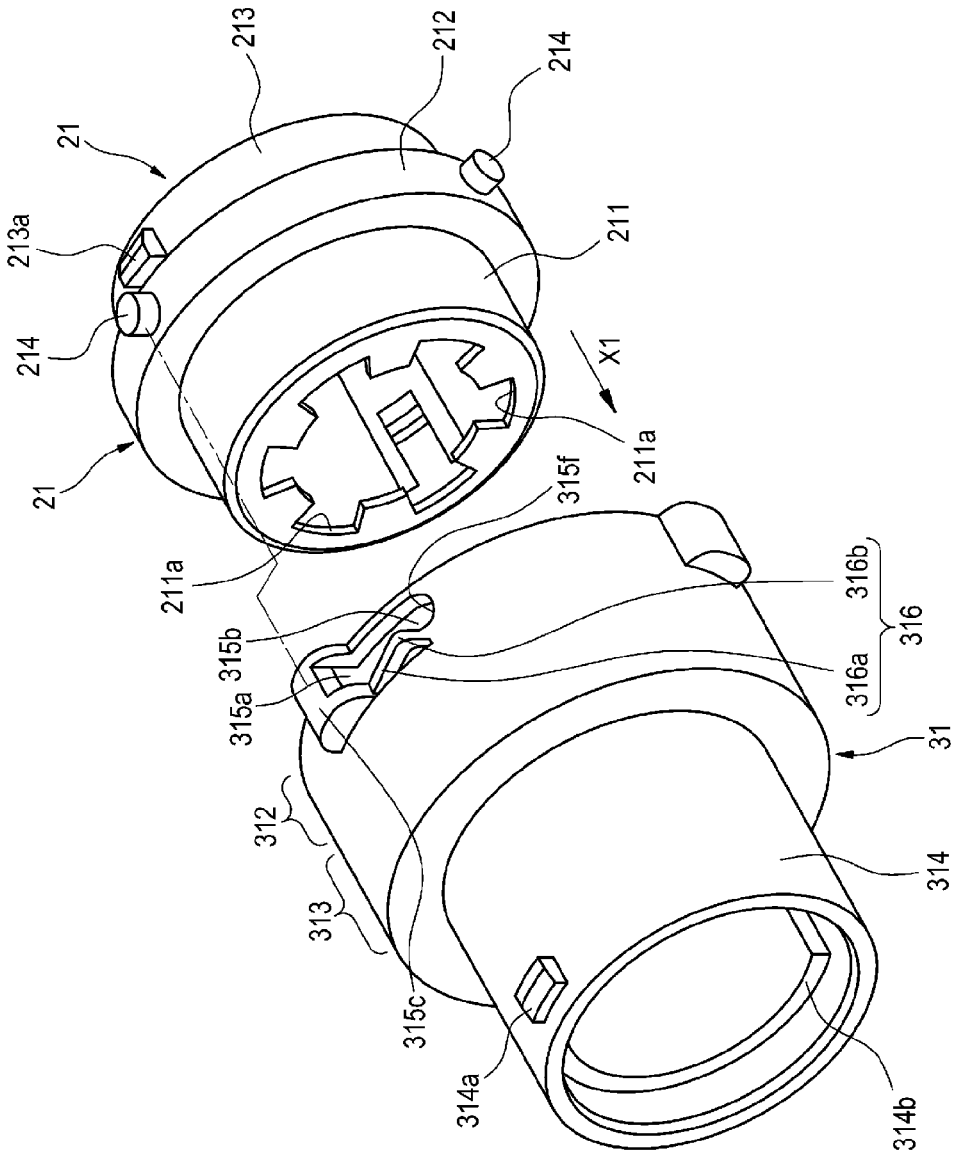

213
212
214
21
213a
211
214
X1
21
211a
315f
211a
316b
315b
316
315a
316a
31
312
314
313
315c
314a
314b

Fig. 5

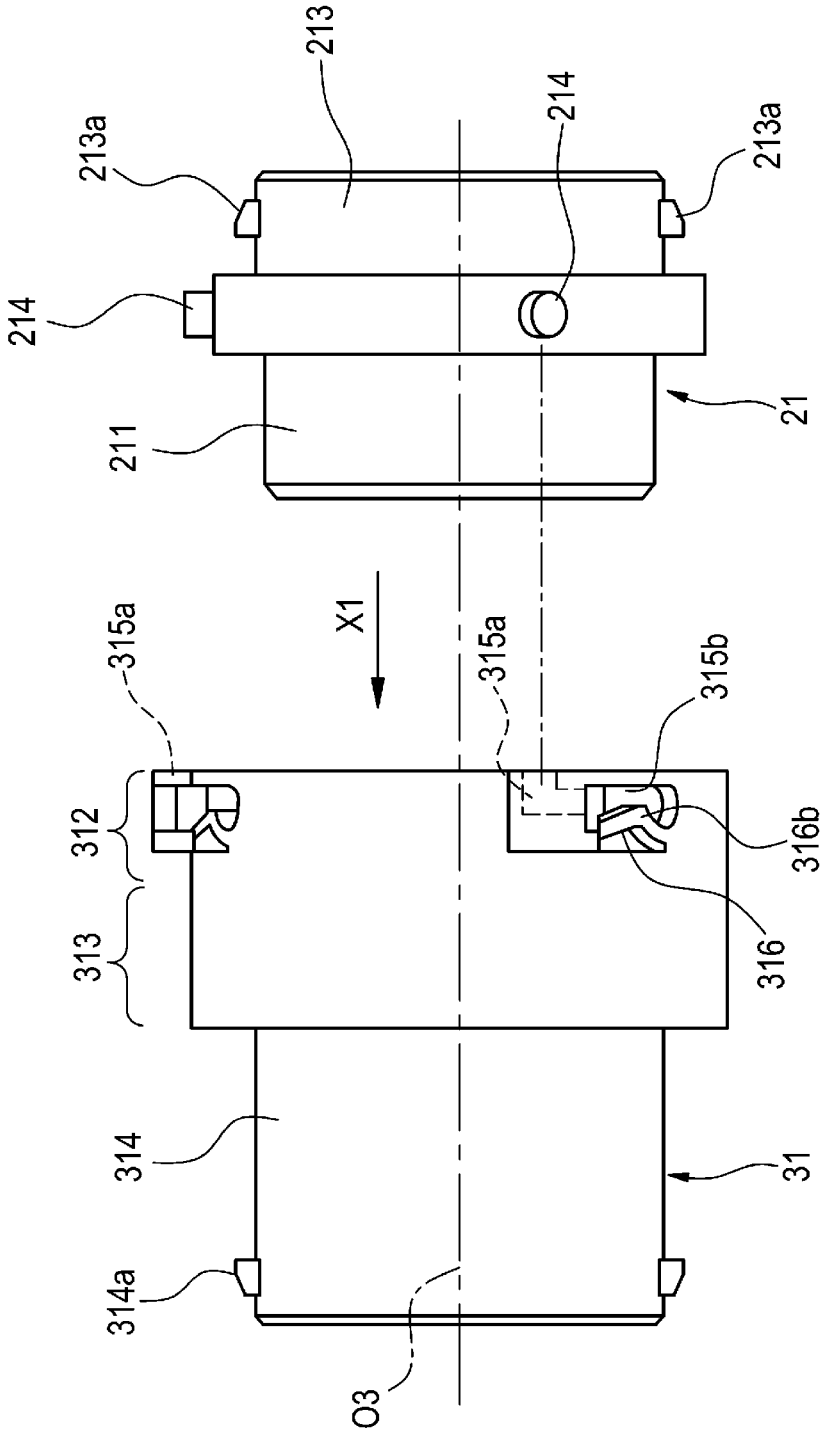

213
214
213a
213a
214
211
21
X1
315a
315a
315b
312
313
316b
316
314
31
314a
O3

Fig. 6

Fig. 7

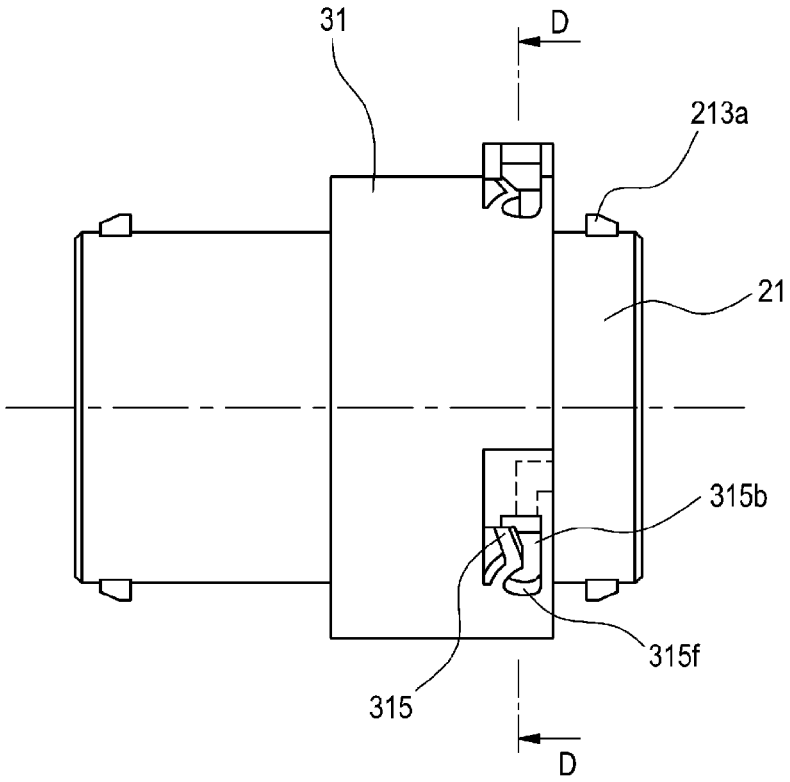

31
D
213a
21
315b
315f
315
D

Fig. 8

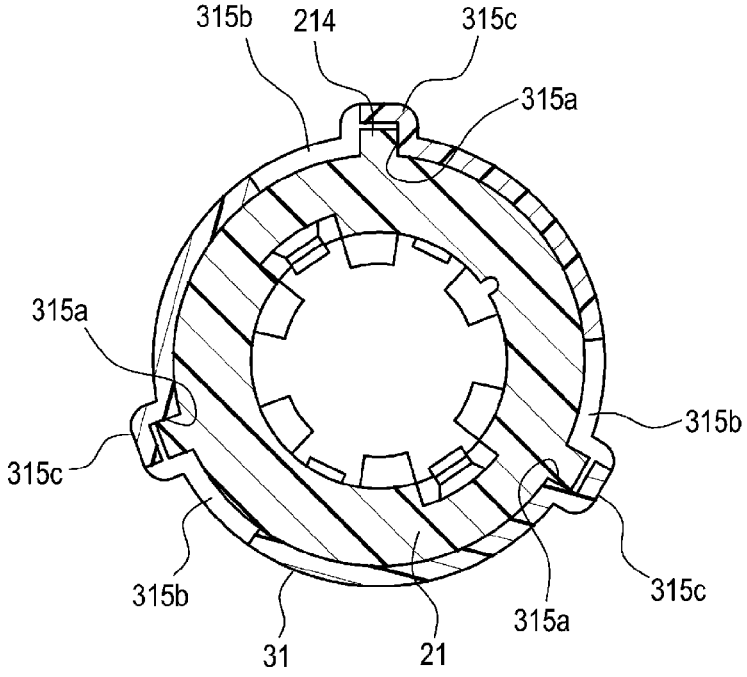

315b
214
315c
315a
315a
315b
315c
315b
315a
315c
31
21

Fig. 9

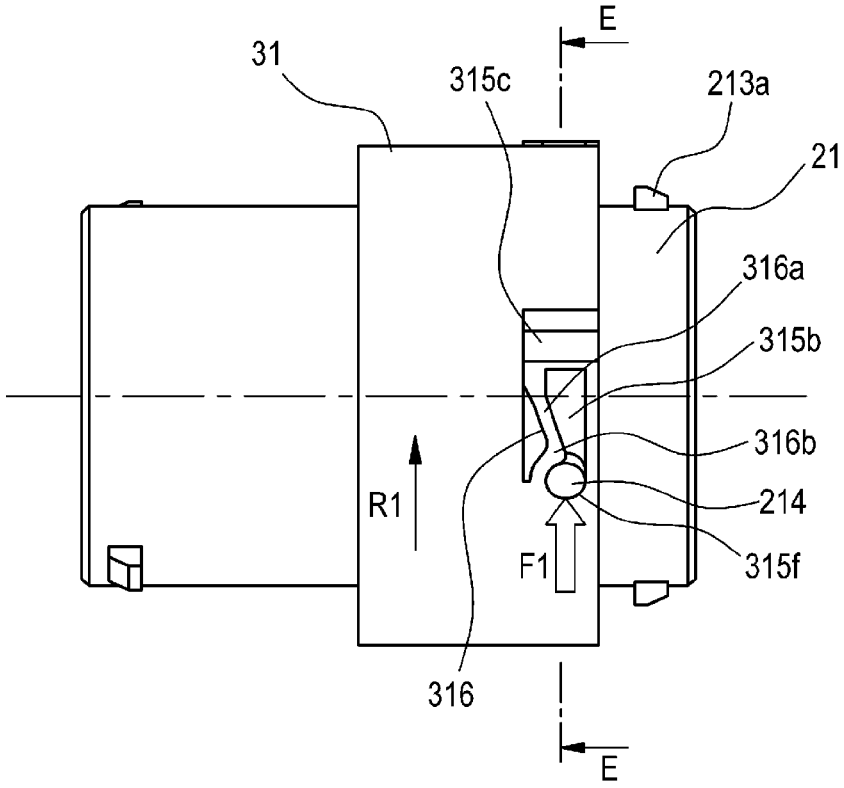

E
31
315c
213a
21
316a
315b
316b
214
315f
R1
F1
316
E

Fig. 10

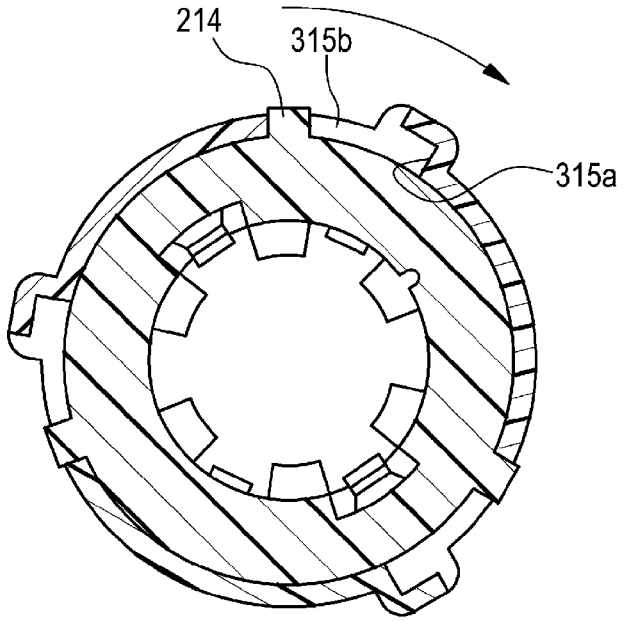

214
315b
315a

Fig. 11

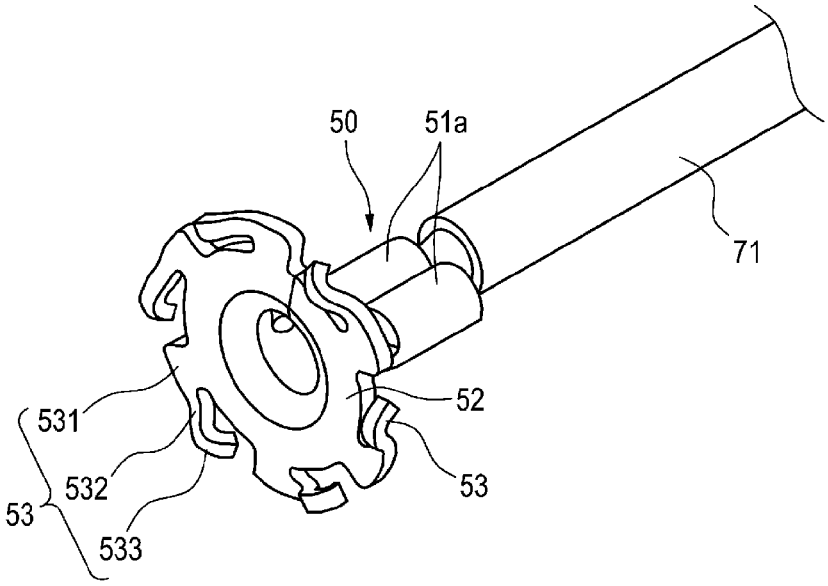
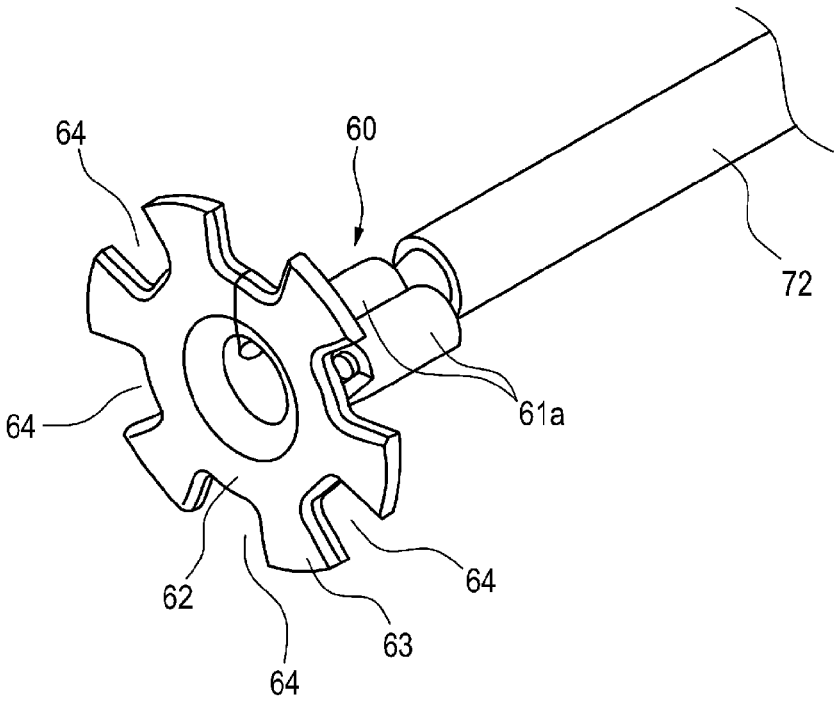


Fig. 12



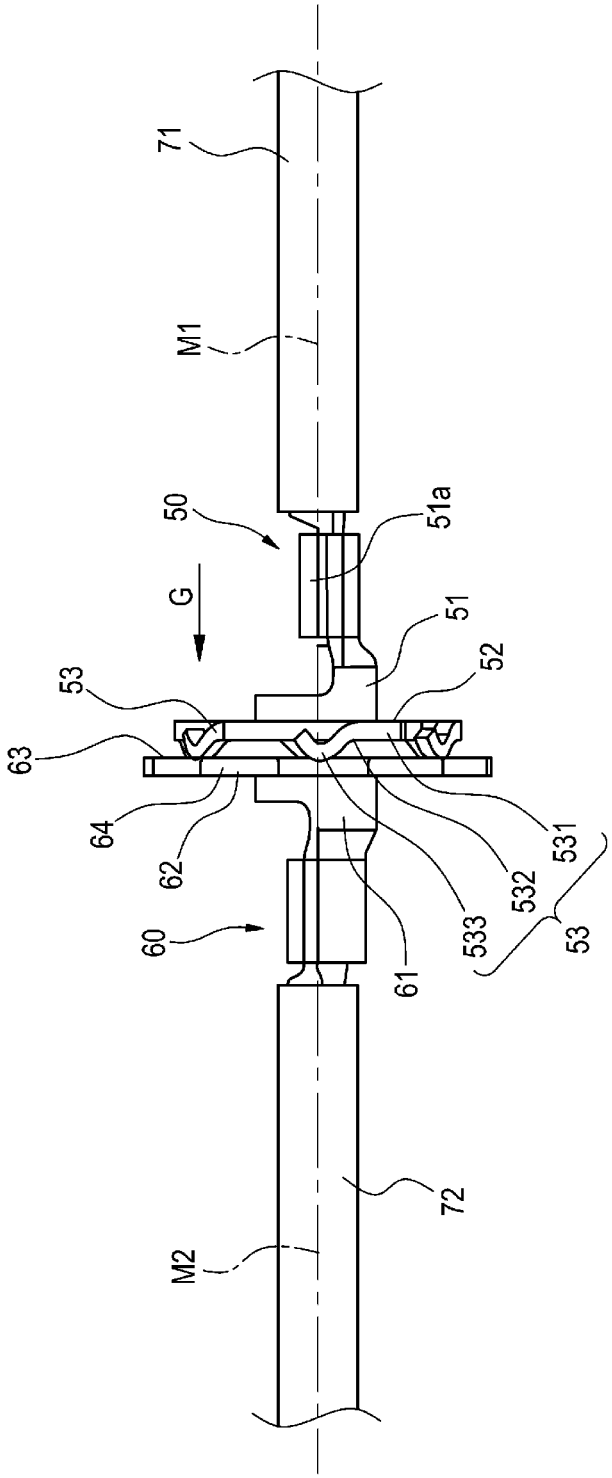


Fig. 13

Fig. 14

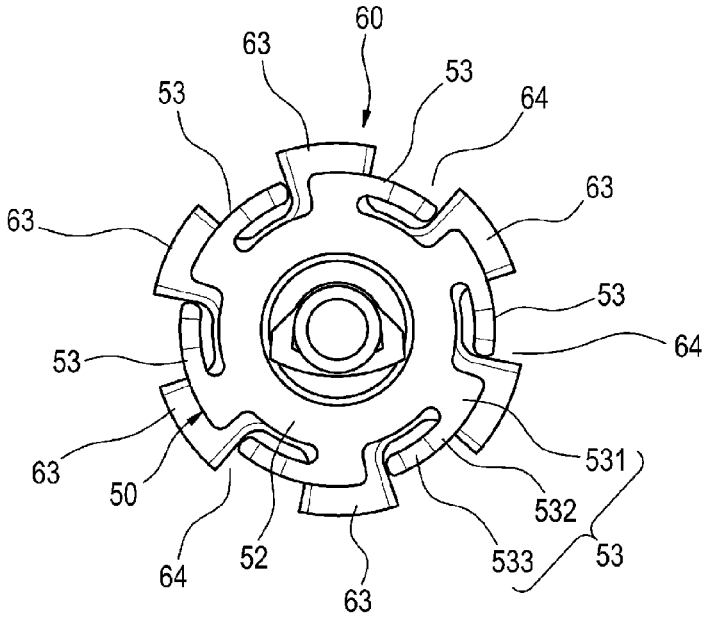
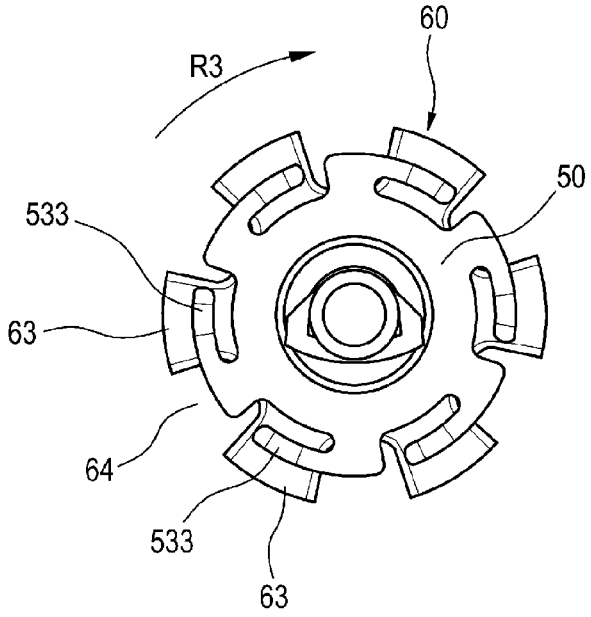

60
63
53
53
64
63
63
53
64
53
531
63
50
532
64
52
533
53
63

Fig. 15


60
R3
50
533
63
64
533
63

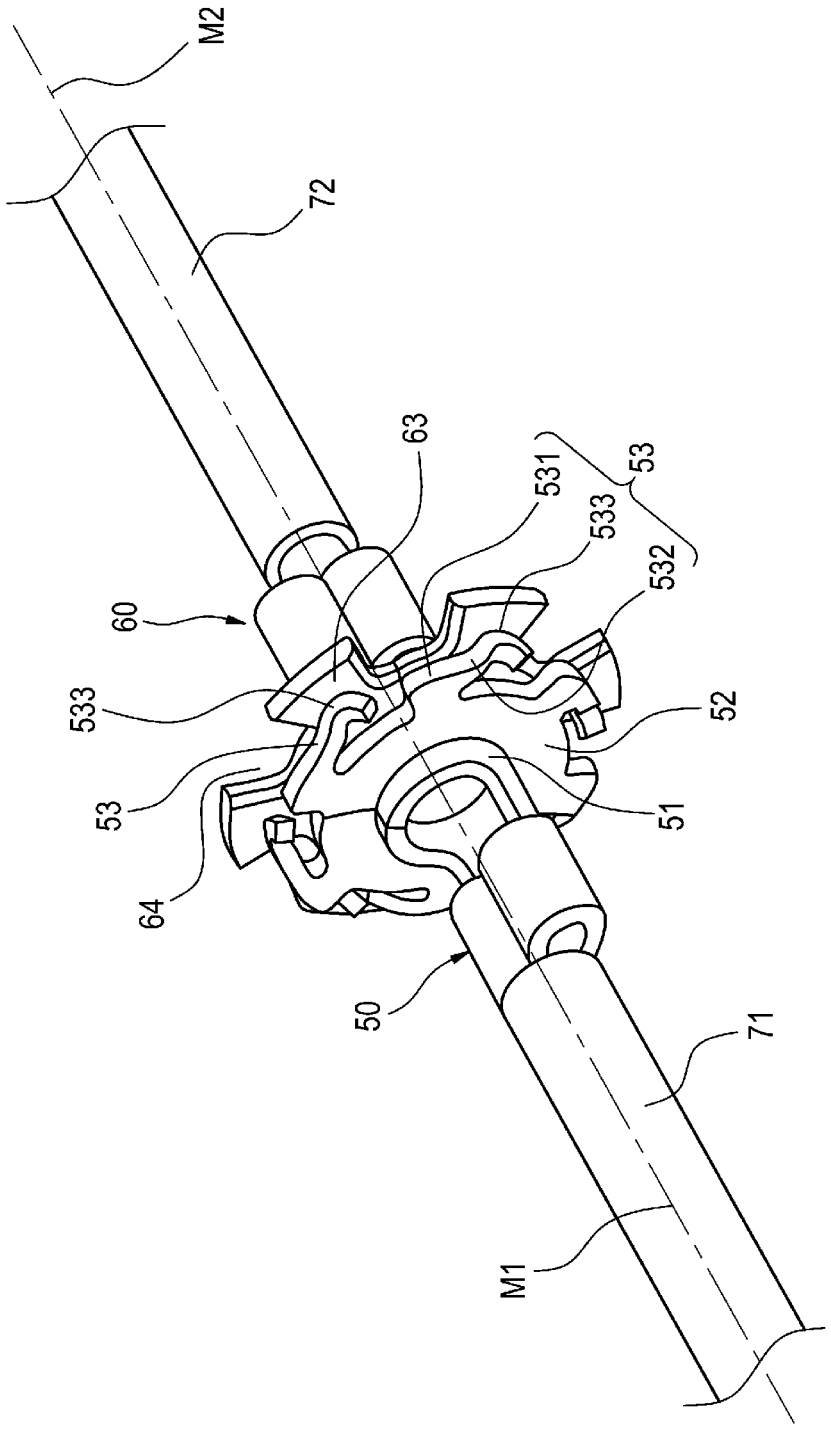
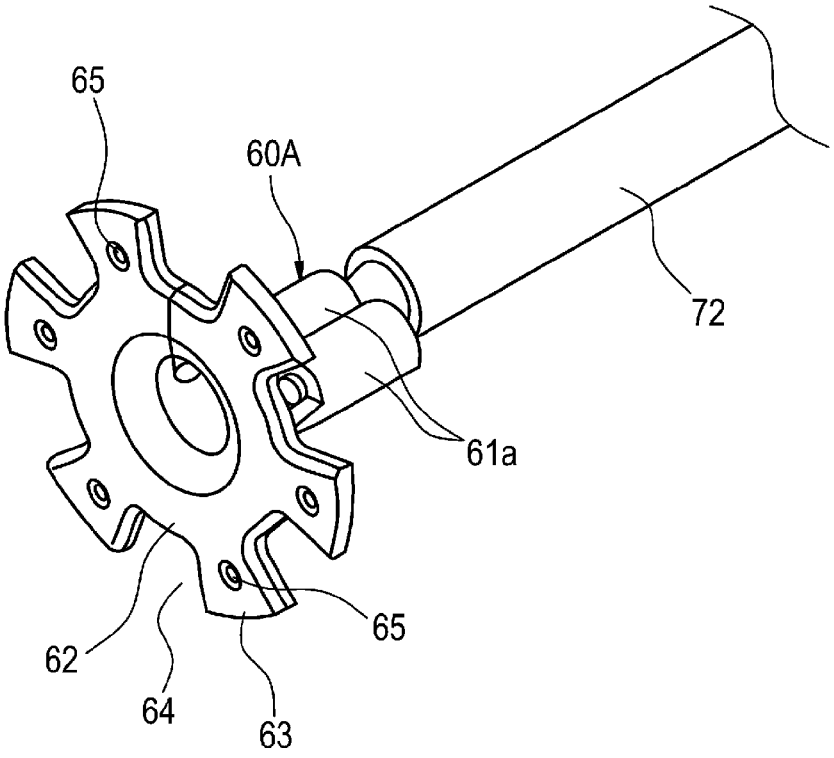


Fig. 16

Fig. 17



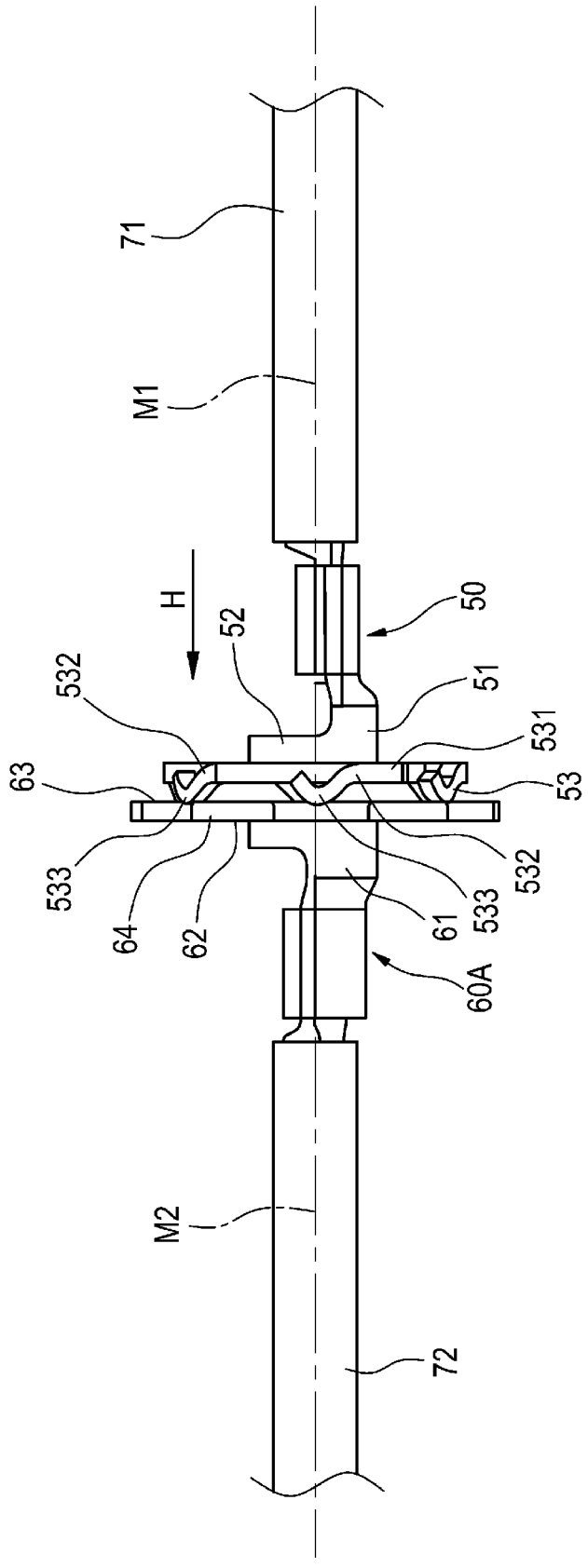


Fig. 18

Fig. 19

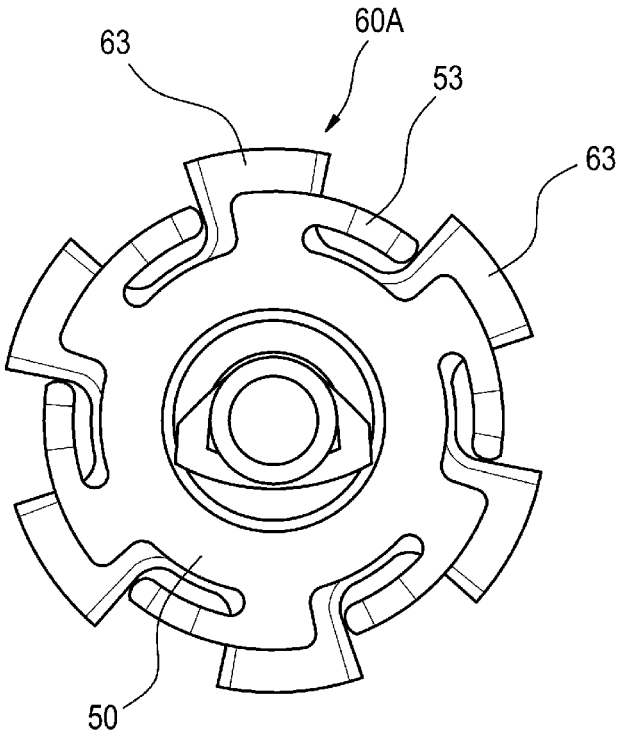


Fig. 20

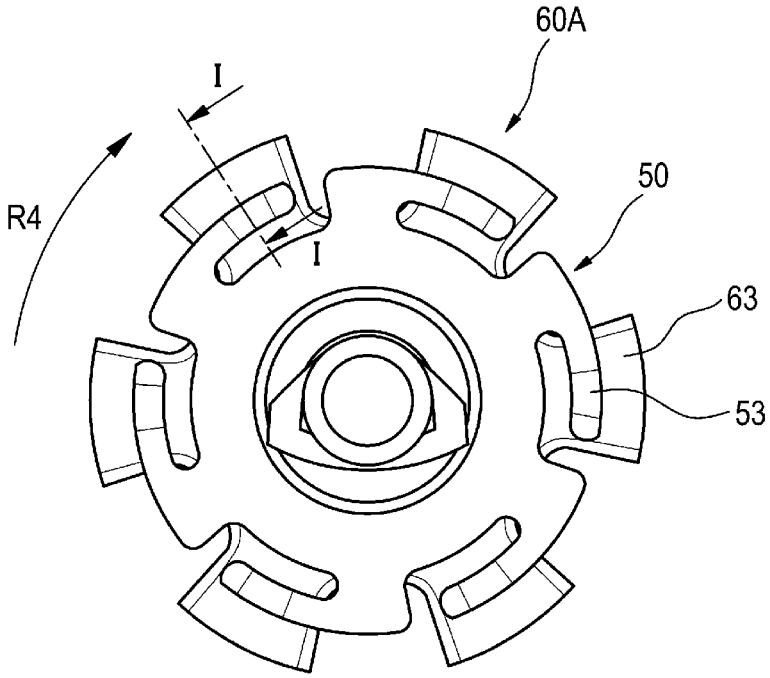


Fig. 21

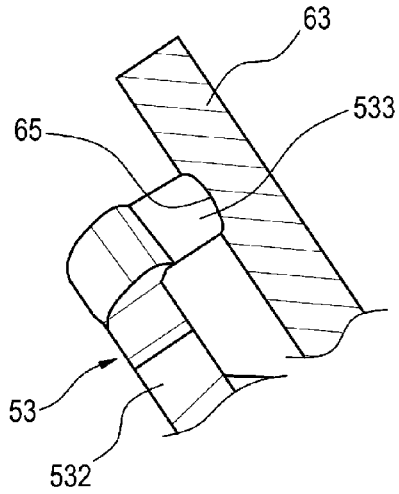


Fig. 22

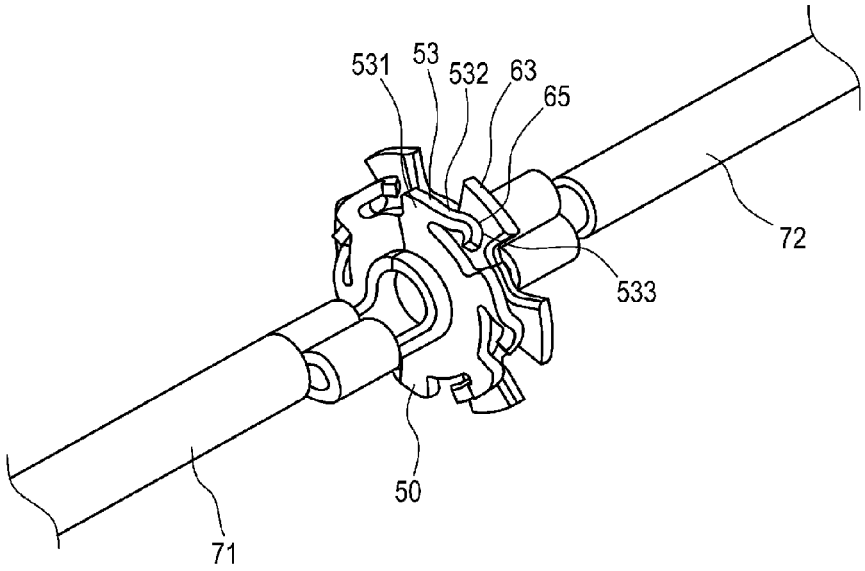


Fig. 23

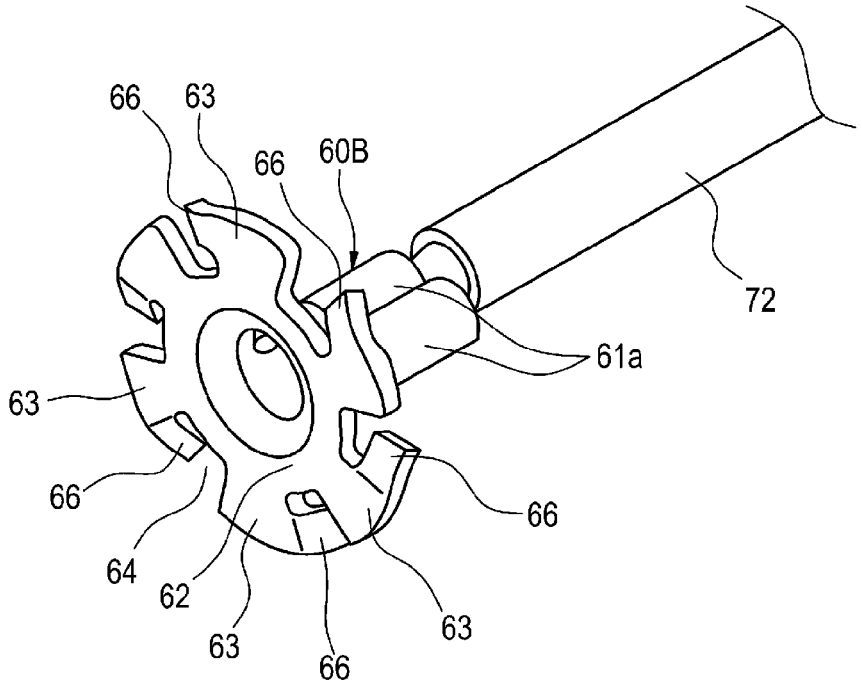

66
63
66
60B
72
61a
63
66
66
64
62
63
63
66

Fig. 24

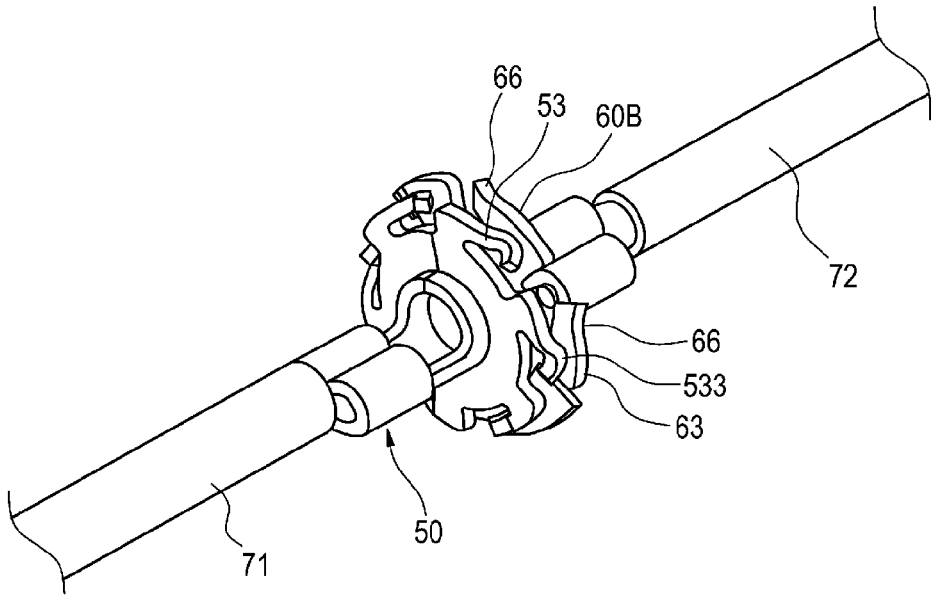

66
53
60B
72
66
533
63
50
71

Fig. 25A

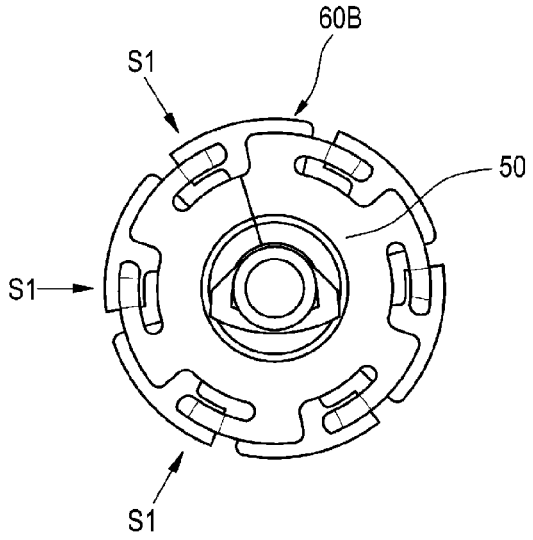


Fig. 25B

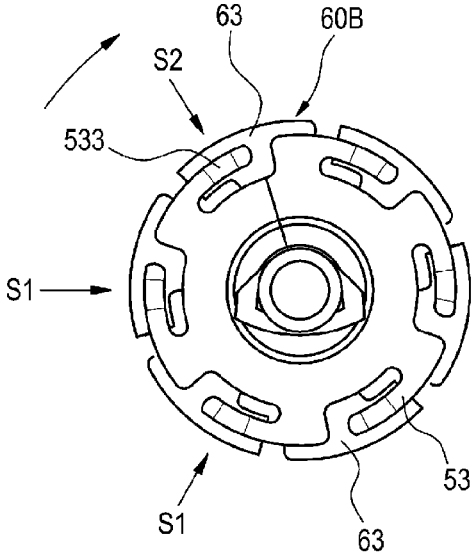


Fig. 25C

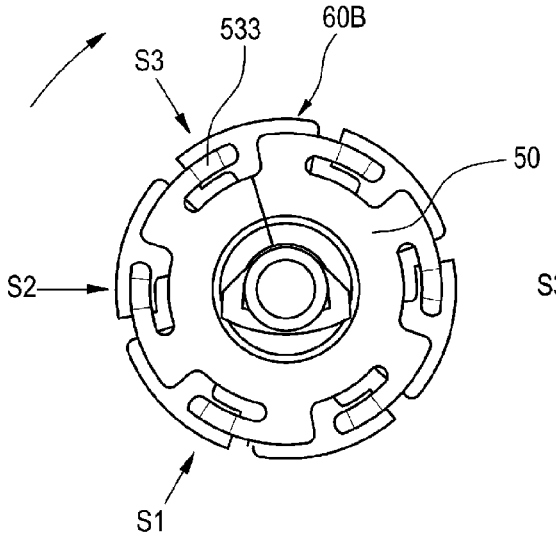


Fig. 25D

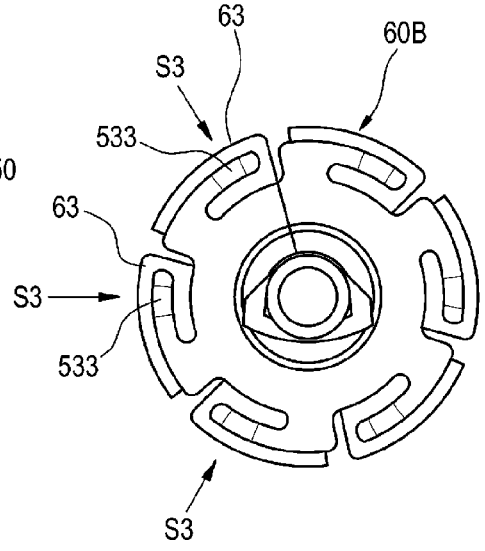


Fig. 26A

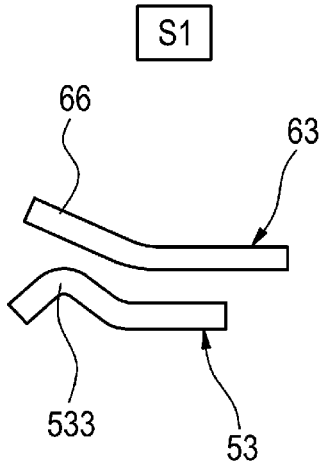


Fig. 26B

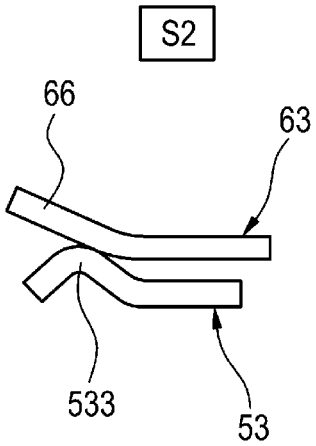


Fig. 26C

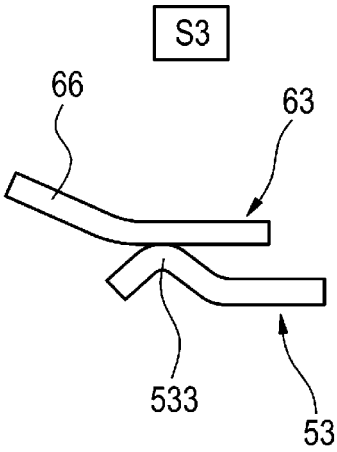


Fig. 27

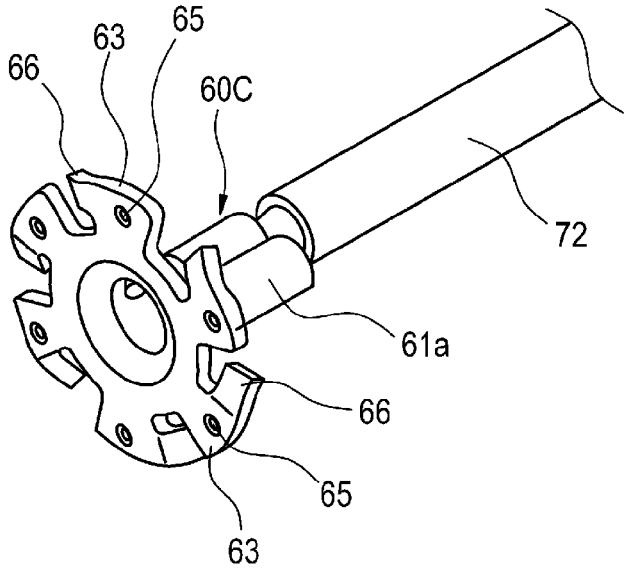
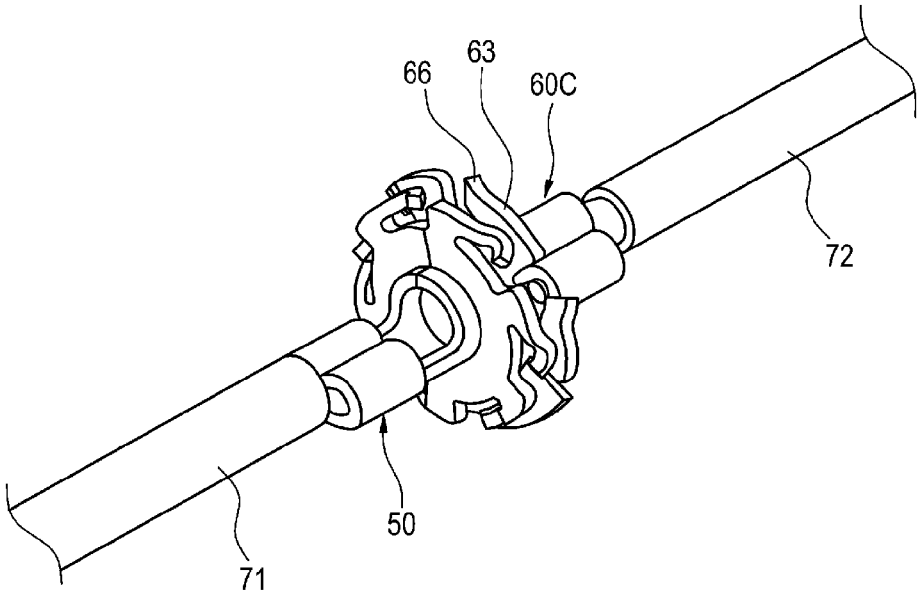


Fig. 28



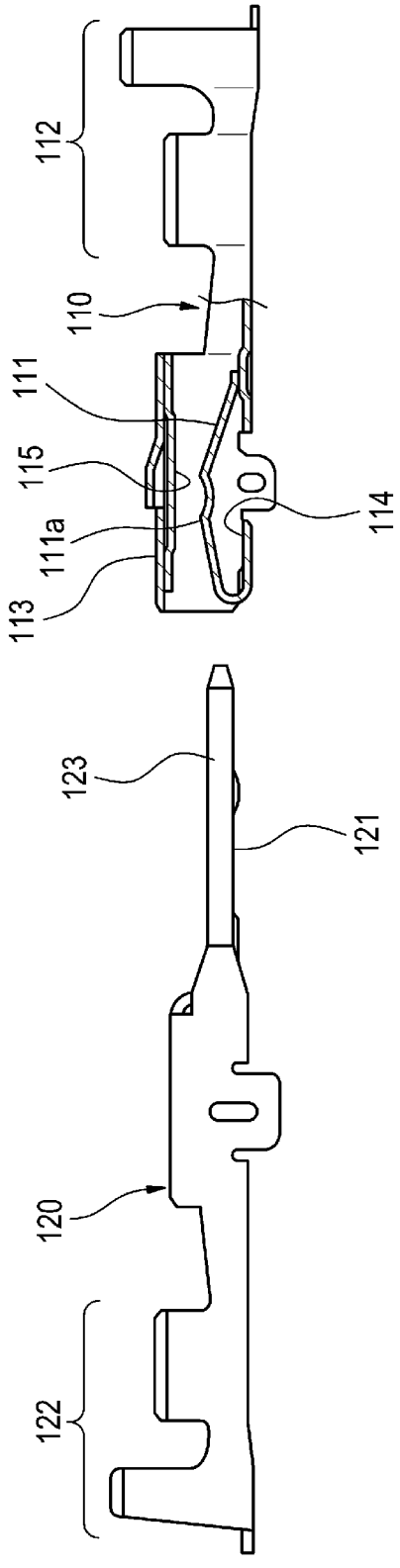
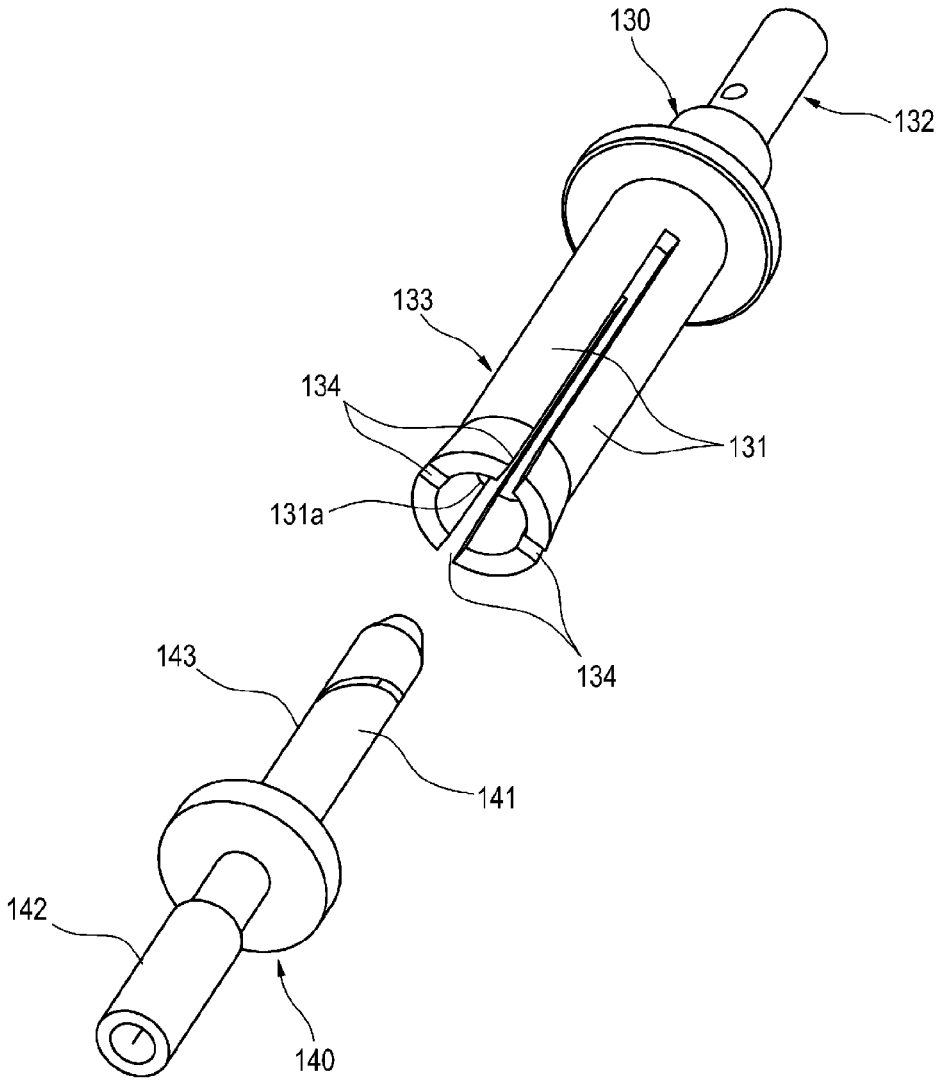


Fig. 29

Fig. 30



TERMINAL FITTING CONNECTION STRUCTURE AND ROTARY FITTING-TYPE CONNECTOR

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation of PCT application No. PCT/JP2014/067675, which was filed on Jul. 2, 2014 based on Japanese Patent Application (No. 2013-139097) filed on Jul. 2, 2013, the contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a terminal fitting connection structure, and a rotary fitting type connector which electrically connects terminal fittings to each other using the terminal fitting connection structure.

2. Description of the Related Art

FIG. **29** illustrates a terminal fitting connection structure disclosed in PTL 1 as below, and FIG. **30** illustrates a terminal fitting connection structure disclosed in PTL 2 as below.

In the terminal fitting connection structure of PTL 1, a contact spring piece **111** provided in a first terminal fitting **110** comes into pressing contact with a contact surface **121** provided in a second terminal fitting **120** such that the first terminal fitting **110** and the second terminal fitting **120** enter a state of being electrically connected to each other.

The first terminal fitting **110** in PTL 1 is a female type terminal fitting formed by press forming of a metal plate, and includes an electric wire connection portion **112** which clamps and connects an electric wire, and a fitting portion **113** having a rectangular tube shape to which the tip end portion of a male type terminal fitting is fitted. The fitting portion **113** having a rectangular tube shape nips the tip end portion of the male type terminal fitting between the contact spring piece **111**, which is bent toward the inside of the rectangular tube from the front end of a lower wall portion **114** and extends in the axial direction of the first terminal fitting **110**, and an upper wall portion **115** which opposes the contact spring piece **111**. A contact portion **111***a* which comes into contact with the contact surface **121** is formed to protrude from the contact spring piece **111**.

The second terminal fitting **120** in PTL 1 is a male type terminal fitting formed by press forming of a metal plate, and includes an electric wire connection portion **122** which clamps and connects an electric wire, and a tongue-shaped tip end portion **123** which is inserted into the fitting portion **113** of the first terminal fitting **110**. The surface of the tongue-shaped tip end portion **123** functions as the contact surface **121** which comes into pressing contact with the contact spring piece **111**.

In the terminal fitting connection structure of PTL 2, a contact spring piece **131** provided in a first terminal fitting **130** comes into pressing contact with a contact surface **141** provided in a second terminal fitting **140** such that the first terminal fitting **130** and the second terminal fitting **140** enter a state of being electrically connected to each other.

The first terminal fitting **130** in PTL 2 is a female type terminal fitting, and includes a substantially cylindrical barrel portion **132** which clamps and connects an electric wire, and a substantially cylindrical fitting portion **133** to which the tip end portion of a male type terminal fitting is fitted. The fitting portion **133** is formed of slits **134** formed

at four points separated in the peripheral direction of the cylinder. Peripheral wall portions which are separated by the slits **134** and extend in the axial direction of the first terminal fitting **130** function as contact spring pieces **131** which can be deformed to be bent in the radial direction of the cylinder. A contact portion **131***a* which comes into contact with the contact surface **141** is formed to protrude from the inner surface of each of the peripheral wall portions that function as the contact spring pieces **131**.

The second terminal fitting **140** in PTL 2 is a male type terminal fitting, and includes a substantially cylindrical barrel portion **142** which clamps and connects an electric wire, and a round bar-shaped tip end portion **143** which is inserted into the fitting portion **133** of the first terminal fitting **130**. The outer peripheral surface of the tip end portion **143** functions as the contact surface **141** which comes into pressing contact with the contact spring piece **131**.

[PTL 1] JP-A-2000-277197
[PTL 2] JP-A-2011-228061

SUMMARY OF THE INVENTION

However, in the case of the terminal fitting connection structure of any of PTLs 1 and 2, the contact spring piece **111** extends in the axial direction of the terminal fitting. Therefore, when a sufficient length for the contact spring piece **111** is ensured in order to ensure stable flexibility for the contact spring piece **111**, the axial length of the terminal fitting is increased, and there is a problem in that an increase in the size of the terminal fitting or an increase in the size of a connector which accommodates the terminal fitting is incurred.

In addition, in the case of the terminal fitting connection structure of any of PTLs 1 and 2, the contact areas between the contact surfaces **121** and **141** and the contact portions **111***a* and **131***a* are small, and thus there is a problem in that it is difficult to reduce the conductor resistance in contact portions of the terminal fittings.

Here, an object of the present invention is to provide a terminal fitting connection structure capable of achieving reduction in the size of a connector which accommodates terminal fittings by reducing the axial length of the terminal fittings, and of enhancing the reliability of electrical connection by reducing the conductor resistance in contact portions of the terminal fittings, and to provide a rotary fitting type connector capable of realizing a reduction in size by electrically connecting the terminal fittings to each other using the terminal fitting connection structure.

The above-mentioned object of the present invention is accomplished by the following configurations.

(1) A terminal fitting connection structure which presses contact spring pieces provided in a first terminal fitting to contact surfaces provided in a second terminal fitting so as to contact thereto, so that the first terminal fitting and the second terminal fitting are electrically connected to each other, wherein

the first terminal fitting includes:

a first terminal body which extends on a center axis of the first terminal fitting and has a base end to which an electric wire is connected substantially coaxially with the center axis of the first terminal fitting,

a first annular portion which is formed at a tip end of the first terminal body in an annular shape concentrically with the center axis of the first terminal fitting, and

a plurality of the contact spring pieces which are provided at a plurality of points arranged on an outer periphery

of the first annular portion at predetermined intervals in a peripheral direction of the first annular portion,

the contact spring piece includes:

a spring support portion which extends outward in a radial direction of the first annular portion from the outer periphery of the first annular portion,

an elastic piece which extends from the spring support portion along the outer periphery of the first annular portion and has a tip end side that is displaceable in a direction of the center axis of the first terminal fitting, and

a contact protrusion which protrudes from the elastic piece so as to protrude further toward a mated terminal side than a tip end of the first annular portion, and

the second terminal fitting includes:

a second terminal body which extends on a center axis of the second terminal fitting and has a base end to which an electric wire is connected substantially coaxially with the center axis of the second terminal fitting,

a second annular portion which is provided at a tip end of the second terminal body in the same annular shape as that of the first annular portion of the first terminal fitting concentrically with the center axis of the second terminal fitting,

a plurality of the contact surfaces which protrude outward in a radial direction of the second annular portion from an outer periphery of the second annular portion at the same intervals as those of the plurality of the contact protrusions in the first terminal fitting, and

a plurality of contact release portions which are positioned between the adjacent contact surfaces and allow the contact protrusions to be inserted into the contact release portions.

(2) The terminal fitting connection structure described in (1), in which the plurality of the contact surfaces of the second terminal fitting are provided with recessed portions to which the contact protrusions that ride on the contact surfaces are fitted.

(3) The terminal fitting connection structure described in (1) or (2), in which one side edge of each of the plurality of the contact surfaces of the second terminal fitting, which faces the contact release portion, is provided with an inclined surface which guides the contact protrusion that is inserted into the contact release portion onto the contact surface.

(4) The terminal fitting connection structure described in any one of (1) to (3), in which an arrangement of the contact protrusions and the contact surfaces is set so that portions of the plurality of the contact protrusions provided in the first terminal fitting ride on the contact surfaces of the second terminal fitting at timings different from those of the other contact protrusions.

(5) A rotary connector which allows terminal fittings to enter a state of being electrically connected to each other by using the terminal fitting connection structure described in any one of (1) to (4), the rotary connector comprising:

a first connector housing which includes

a first housing body which fixes and supports the first terminal fitting on a center axis so as to expose a tip end portion of the first terminal fitting that is fixed and supported from a front end of the first housing body, and has a circular section that is concentric with the center axis, and

a connection pin which protrudes from the first housing body along a radial direction thereof; and

a second connector housing which includes

a second housing body which fixes and supports the second terminal fitting on the center axis so as to expose a tip end portion of the second terminal fitting that is fixed and supported from a front end of the second housing body, has a circular section that is concentric with the center axis, and is fitted to the first housing body,

an axial groove which is cut out from an end portion of the second housing body on the first connector housing side so as to extend along a center axis direction of the second housing body, and allows the connection pin to be inserted into the axial groove when the first housing body is fitted to the second housing body along the center axis direction of the second housing body,

a peripheral groove which extends from an end of the axial groove toward one side in a peripheral direction of the second housing body along the peripheral direction to have a predetermined length, and allows the connection pin to move in the peripheral groove when the first housing body and the second housing body are rotated relative to each other, and

a locking portion which comes into contact with the connection pin from a start side of the peripheral groove when the connection pin reaches an end of the peripheral groove and restricts movement of the connection pin in a return direction, thereby locking a joined state of the connector housings.

According to the configuration of (1), the first terminal fitting and the second terminal fitting are allowed to face each other so as to enable the contact protrusions of the plurality of the contact spring pieces of the first terminal fitting and the plurality of the contact release portions of the second terminal fitting to oppose each other. Next, the first terminal fitting and the second terminal fitting are allowed to abut each other on the same axis so as to allow the plurality of the contact protrusions of the first terminal fitting to be inserted into the plurality of the contact release portions of the second terminal fitting. Thereafter, in the state in which the two terminal fittings abut each other, when the first terminal fitting and the second terminal fitting are rotated relative to each other by a predetermined angle on the same axis, the contact protrusions of the plurality of the contact spring pieces of the first terminal fitting ride on the plurality of the contact surfaces of the second terminal fitting. Accordingly, the contact protrusions of the plurality of the contact spring pieces of the first terminal fitting enter a state of coming into pressing contact with the plurality of the contact surfaces of the second terminal fitting, and thus the first terminal fitting and the second terminal fitting enter the electrically connected state.

In addition, according to the configuration of (1), the contact spring pieces extend in the peripheral direction of the first annular portion at the tip end of the first terminal fitting. That is, the contact spring piece is configured to extend in an arc shape on a plane perpendicular to the axial direction of the first terminal fitting. Therefore, even when a sufficient length for the contact spring piece is ensured in order to ensure stable flexibility for the contact spring piece, the dimensions of the terminal fittings in the axial direction are not affected.

Therefore, even in a case where a necessary and sufficient length for the contact spring piece is ensured, the axial length of the terminal fittings is reduced, resulting in a reduction in the size of the terminal fittings. In addition, due to a reduction in the size of the terminal fittings, a reduction in the size of a connector that accommodates the terminal fittings can be achieved.

In addition, according to the configuration of (1), the electrical connection between the first terminal fitting and the second terminal fitting is achieved by contact between the plurality of the contact protrusions and the plurality of the contact surfaces, and thus the total contact area of the contact portions of the terminal fittings is increased. Therefore, the conductor resistance in the contact portions is decreased, and thus the reliability of the electrical connection can be enhanced.

In addition, the first annular portion and the second annular portion in the configuration of (1) may be a hollow annular portion or may also be a solid annular portion.

According to the configuration of (2), the contact protrusion that rides on the contact surface is fitted to the recessed portion provided in the contact surface such that the recessed portion restricts the movement of the contact protrusion. Therefore, slipping of the contact protrusion on the contact surface due to external vibration transmitted from the electric wires and the like connected to the terminal fittings can be prevented. As a result, the occurrence of problems such as wear or a reduction in contact pressure caused by the slipping of the contact protrusion on the contact surface can be prevented.

According to the configuration of (3), when the contact protrusions of the first terminal fitting that are inserted into the contact release portions of the second terminal fitting ride on the contact surfaces of the second terminal fitting by the relative rotation between the first terminal fitting and the second terminal fitting, since the contact protrusions move on the inclined surface connected to the contact surface, the contact protrusion does not abruptly collide with the edge of the contact surface. Furthermore, the bending deformation amount of the contact spring piece which occurs when the contact protrusion rides on the contact surface is gradually changed. Therefore, a rotating operation force for the contact protrusion of the first terminal fitting to ride on the contact surface of the second terminal fitting can be reduced, and the operability during a rotating operation can be enhanced.

According to the configuration of (4), compared to a case in which all of the plurality of the contact protrusions provided in the first terminal fitting simultaneously ride on the corresponding contact surfaces of the second terminal fitting, as the number of contact protrusions that simultaneously ride on the contact surfaces is reduced, the rotating operation force applied between the two terminal fittings is reduced, and thus operability can be enhanced.

According to the configuration of (5), since the first terminal fitting and the second terminal fitting accommodated in the corresponding connector housings are as described in (1) to (4), the axial lengths of the terminal fittings can be reduced. Therefore, as the axial lengths of the terminal fittings are reduced, the axial lengths of the connector housings can also be reduced. Accordingly, a reduction in the size of the connector is achieved, and thus a mountable ability thereof in a vehicle that is difficult to ensure a sufficient installation space can be enhanced.

In addition, the terminal fittings which are accommodated in the corresponding connector housings are fixed on the center axes of the connector housings. Therefore, the axial movement of the connector housings and the rotating operation of the connector housings around the center axes become the axial movement and the rotating operation of the terminal fittings which are accommodated in the connector housings. On the other hand, moving two in an axial direction from a state in which the two face each other on the same axis so as to allow the two to abut each other, and then rotating the two that abut each other relative to each other by a predetermined angle are common to both a necessary operation for joining the connector housings included in the connector and a necessary operation for electrically connecting the terminal fittings to each other.

Therefore, by allowing a necessary relative rotation angle for a transition of the connector housings from an abutting state to a lock completed state to be the same as a necessary relative rotation angle for a transition from an abutting state in which the contact protrusions of the first terminal fitting are inserted into the contact release portions of the second terminal fitting to the electrically connected state in which the contact protrusions of the first terminal fitting ride on the contact surfaces of the second terminal fitting, when the joining of the connector housings and is locked, the terminal fittings which are respectively accommodated in the connector housings simultaneously can be allowed to enter the electrically connected state.

According to the terminal fitting connection structure in the present invention, a reduction in the size of a connector which accommodates terminal fittings can be achieved by reducing the axial length of the terminal fittings, and the reliability of electrical connection can be enhanced by reducing the conductor resistance in contact portions of the terminal fittings.

In addition, in the rotary connector according to the present invention, a mountable ability of the connector in a vehicle can be enhanced by realizing a reduction in the size of the connector, and when the joining of the connector housings is locked, the terminal fittings which are respectively accommodated in the connector housings simultaneously can be allowed to enter the electrically connected state.

Hereinabove, the present invention has been concisely described. Furthermore, the details of the present invention will become more apparent by reading through embodiments for embodying the invention described below (hereinafter, referred to as "embodiments") with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of an assembled state of a first embodiment of a rotary connector according to the present invention.

FIG. **2** is a view viewed from arrow A of FIG. **1**.

FIG. **3** is a sectional view taken along line B-B of FIG. **2**.

FIG. **4** is an exploded perspective view of the rotary connector of the first embodiment of the present invention.

FIG. **5** is a perspective view of a state in which a first connector housing and a second connector housing of the first embodiment of the present invention face each other.

FIG. **6** is a plan view of the state in which the first connector housing and the second connector housing of the first embodiment of the present invention face each other.

FIG. **7** is an external view of a state in which the connector housings are fitted to each other in an axial direction and a connection pin reaches the end of an axial groove of a second housing body in the first embodiment of the present invention.

FIG. **8** is a sectional view taken along line D-D of FIG. **7**.

FIG. **9** is an external view of a state in which joining of the connector housings is locked in the first embodiment of the present invention.

FIG. **10** is a sectional view taken along line E-E of FIG. **9**.

FIG. **11** is an enlarged view of a first terminal fitting illustrated in FIG. **4**.

FIG. **12** is an enlarged view of a second terminal fitting illustrated in FIG. **4**.

FIG. **13** is a side view of a state in which the first terminal fitting and the second terminal fitting abut each other in the first embodiment.

FIG. **14** is a view viewed from arrow G of FIG. **13**.

FIG. **15** is an explanatory view of a state in which the second terminal fitting is rotated relative to the first terminal fitting by a predetermined angle in arrow R**3** direction from the state of FIG. **14** and a contact protrusion of the first terminal fitting rides on a contact surface of the second terminal fitting.

FIG. **16** is a perspective view of the first terminal fitting and the second terminal fitting in a connected state illustrated in FIG. **15**.

FIG. **17** is a perspective view of a second embodiment of the second terminal fitting according to the present invention.

FIG. **18** is a side view of a state in which the second terminal fitting illustrated in FIG. **17** and the first terminal fitting illustrated in FIG. **11** abut each other.

FIG. **19** is a view viewed from arrow H of FIG. **18**.

FIG. **20** is an explanatory view of a state in which the second terminal fitting is rotated relative to the first terminal fitting by a predetermined angle in arrow R**4** direction from the state of FIG. **19** and the contact protrusion of the first terminal fitting rides on the contact surface of the second terminal fitting.

FIG. **21** is a partial sectional view taken along line I-**1** of FIG. **20**.

FIG. **22** is a perspective view of the first terminal fitting and the second terminal fitting in a connected state illustrated in FIG. **20**.

FIG. **23** is a perspective view of a third embodiment of the second terminal fitting according to the present invention.

FIG. **24** is a side view of a state in which the second terminal fitting illustrated in FIG. **23** and the first terminal fitting illustrated in FIG. **11** abut each other.

FIGS. **25**A to **25**D are explanatory views of a transition of the connected state during relative rotation between the second terminal fitting of the third embodiment and the first terminal fitting, in which FIG. **25**A is an explanatory view of the connected state in an initial abutting state of the terminal fittings, FIG. **25**B is an explanatory view of the connected state in a first stage transited from FIG. **25**A by predetermined relative rotation, FIG. **25**C is an explanatory view of the connected state in a second stage transited from FIG. **25**B by predetermined relative rotation, and FIG. **25**D is an explanatory view of a connection completed state transited from FIG. **25**C by predetermined relative rotation.

FIGS. **26**A to **26**C are explanatory views of three modes of the connected state of the contact protrusion and the corresponding contact surface illustrated in FIGS. **25**A to **25**D.

FIG. **27** is a perspective view of a fourth embodiment of the second terminal fitting according to the present invention.

FIG. **28** is a perspective view of a state in which the second terminal fitting illustrated in FIG. **27** and the first terminal fitting illustrated in FIG. **11** abut each other.

FIG. **29** is an explanatory view of each of terminal fittings connected by a terminal fitting connection structure according to the related art.

FIG. **30** is an explanatory view of each of terminal fittings connected by another terminal fitting connection structure according to the related art.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

Hereinafter, embodiments of a terminal fitting connection structure and a rotary fitting type connector according to the present invention will be described in detail with reference to the drawing.

First Embodiment

First, after initially describing a rotary connector **10** of a first embodiment, a terminal fitting connection structure of the first embodiment will be described in detail.

Description of Rotary Connector **10** of First Embodiment

FIGS. **1** to **10** illustrate a first embodiment of a rotary connector according to the present invention. FIG. **1** is a perspective view of an assembled state of the first embodiment of the rotary connector according to the present invention, FIG. **2** is a view viewed from arrow A of FIG. **1**, FIG. **3** is a sectional view taken along line B-B of FIG. **2**, FIG. **4** is an exploded perspective view of the rotary connector of the first embodiment of the present invention, FIG. **5** is a perspective view of a state in which a first connector housing and a second connector housing of the first embodiment of the present invention face each other, FIG. **6** is a plan view of the state in which the first connector housing and the second connector housing of the first embodiment of the present invention face each other, FIG. **7** is an external view of a state in which the connector housings are fitted to each other in an axial direction and a connection pin reaches the end of an axial groove of a second housing body in the first embodiment of the present invention, FIG. **8** is a sectional view taken along line D-D of FIG. **7**, FIG. **9** is an external view of a state in which joining of the connector housings is locked in the first embodiment of the present invention, and FIG. **10** is a sectional view taken along line E-E of FIG. **9**.

The rotary connector **10** of the first embodiment includes, as illustrated in FIGS. **1** to **5**, a first connector housing **20**, and a second connector housing **30** which is fitted and connected to the first connector housing **20**.

As illustrated in FIGS. **3** and **4**, the first connector housing **20** includes a first housing body **21** which accommodates a first terminal fitting **50** and has a substantially cylindrical shape, a front holder **22** which is fitted and attached to the inner periphery of the tip end (in FIG. **3**, left end) side of the first housing body **21**, an annular packing **23** which is fitted and attached to the outer periphery of the tip end side of the first housing body **21**, a first rubber stopper **24** which is fitted and attached to the inner periphery of the base end (in FIG. **3**, right end) side of the first housing body **21**, and a rear holder **25** which covers the base end of the first housing body **21**.

As illustrated in FIG. **3**, the first housing body **21** includes a tip end side cylindrical portion **211** having an inner periphery to which the front holder **22** is fitted, a cylindrical barrel portion **212** which is connected to the rear end of the tip end side cylindrical portion **211** and has a greater outer diameter than that of the tip end side cylindrical portion **211**, and a cylindrical base end cylindrical portion **213** which is

connected to the rear end of the barrel portion **212** and has a smaller outer diameter than that of the barrel portion **212**.

The transverse sectional shape of the outer periphery of any of the tip end side cylindrical portion **211**, the barrel portion **212**, and the base end cylindrical portion **213** is circular. In addition, the tip end side cylindrical portion **211**, the barrel portion **212**, and the base end cylindrical portion **213** have cylindrical shapes having a common axis. In addition, when externally viewed, the barrel portion **212** extends on the base end side of the tip end side cylindrical portion **211** in a flange shape.

As illustrated in FIG. **5**, the front end surface of the tip end side cylindrical portion **211** is provided with cut-outs **211***a* which are engaged with the outer periphery of the tip end of the first terminal fitting **50** to stop the rotation of the first terminal fitting **50**.

In the case of the first housing body **21** of this embodiment, connection pins **214** are provided at three points which are separated in the peripheral direction of the outer periphery of the barrel portion **212**. The connection pins **214** at the three points have a columnar shape and are provided to extend outward in the radial direction of the barrel portion **212**. In addition, the three points at which the connection pins **214** are provided are positions that trisect the outer periphery of the barrel portion **212**.

As illustrated in FIG. **3**, locking protrusions **213***a* for locking the rear holder **25** protrude from the outer periphery of the base end cylindrical portion **213** of the first housing body **21**. The locking protrusions **213***a* are provided at two points of the outer periphery of the base end cylindrical portion **213**.

As illustrated in FIG. **3**, the front holder **22** is fitted to the inner periphery of the front end side of the tip end side cylindrical portion **211** and determines the axial position of the first terminal fitting **50**. The first terminal fitting **50** is fixed on a center axis C**1** of the first housing body **21** via the front holder **22** so that the tip end surface thereof is exposed from the tip end of the tip end side cylindrical portion **211**. In other words, the first housing body **21** fixes and supports the first terminal fitting **50** so that the tip end portion of the first terminal fitting **50** is exposed from the front end thereof.

The packing **23** is fitted to the outer periphery of the tip end side cylindrical portion **211**. The outer periphery of the packing **23** comes into close contact with the cylindrical portion of a second housing body **31** in the second connector housing **30**, which will be described later such that the fitted portion of the first housing body **21** and the second housing body **31** is water-tightly sealed.

As illustrated in FIG. **3**, the first rubber stopper **24** is fitted and attached to the inner periphery of the base end cylindrical portion **213** of the first housing body **21**. A portion of the base end cylindrical portion **213** to which the first rubber stopper **24** is attached is provided with a stepped portion **213***b* which has a greater diameter than the inner diameter of the tip end side cylindrical portion **211** side and abuts the outer peripheral edge of the first rubber stopper **24**. The first rubber stopper **24** of this embodiment water-tightly seals a gap between the outer periphery of an electric wire **71** which is drawn from the base end side of the first housing body **21** toward the outside and the inner peripheral portion of the base end side of the first housing body **21**.

As illustrated in FIG. **4**, the rear holder **25** includes a disk portion **251** which covers the opening of the base end cylindrical portion **213**, and a cylindrical portion **252** which extends from the outer periphery of the disk portion **251** and is fitted to the outer periphery of the base end cylindrical portion **213**. The center of the disk portion **251** is provided with an electric wire insertion hole **253** through which the electric wire **71** is inserted. Engagement holes **254** which are engaged with the locking protrusions **213***a* on the base end cylindrical portion **213** are formed in the cylindrical portion **252**. The cylindrical portion **252** is provided with slits **255** on both sides of the engagement hole **254**. The slit **255** allows a portion having the engagement hole **254** to be easily elastically deformed. The rear holder **25** mounted on the base end cylindrical portion **213** presses the first rubber stopper **24** attached to the inner periphery of the base end cylindrical portion **213** against the stepped portion **213***b* so as to fix the first rubber stopper **24**.

As illustrated in FIGS. **3** and **4**, the second connector housing **30** includes a second housing body **31** which accommodates a second terminal fitting **60** and has a substantially cylindrical shape, a front holder **32** which is fitted and attached to the inner periphery of the tip end (in FIG. **3**, right end) side of the second housing body **31**, a second rubber stopper **34** which is fitted and attached to the inner periphery of the base end (in FIG. **3**, left end) side of the second housing body **31**, and a rear holder **35** which covers the base end of the second housing body **31**.

As illustrated in FIG. **3**, the second housing body **31** includes a cylindrical portion **312** to which the barrel portion **212** of the first connector housing **20** is fitted, and intermediate cylindrical portion **313** which is connected to the rear end of the cylindrical portion **312** and has a smaller inner diameter than the outer diameter of the barrel portion **212**, and a base end cylindrical portion **314** which is connected to the rear end of the intermediate cylindrical portion **313** and acts as an accommodation portion of the second terminal fitting **60**.

The cylindrical portion **312** is positioned at the tip end of the second housing body **31**. The cylindrical portion **312** is provided with an axial groove **315***a*, a peripheral groove **315***b*, and a locking spring piece **316** at each of the three points corresponding to the connection pins **214** provided on the barrel portion **212**.

The three points on the cylindrical portion **312** at which the axial grooves **315***a* are provided are positions that trisect the outer periphery of the cylindrical portion **312**.

As illustrated in FIGS. **3** and **8**, the axial groove **315***a* is formed to be cut out from the cylindrical portion **312** so as to extend from the opening end of the cylindrical portion **312** along the direction of a center axis O**3** (see FIG. **6**) of the cylindrical portion **312**. As illustrated by arrow X**1** in FIGS. **5** and **6**, when the barrel portion **212** is fitted to the cylindrical portion **312** along the direction of the center axis O**3** of the cylindrical portion **312**, the connection pin **214** on the barrel portion **212** is inserted into the axial groove **315***a*. The groove width of the axial groove **315***a* is set to be slightly greater than the outer diameter of the connection pin **214** so as to allow the connection pin **214** to smoothly move.

In addition, the center axis O**3** of the cylindrical portion **312** is coincident with the center axis C**2** of the second housing body **31** illustrated in FIG. **3**.

As illustrated in FIGS. **6** and **8**, the peripheral groove **315***b* extends from the end of the axial groove **315***a* toward one side in the peripheral direction of the cylindrical portion **312** (toward the lower side in FIG. **6** and counterclockwise in FIG. **8**) along the peripheral direction. The peripheral groove **315***b* is a groove in which the connection pin **214** moves when the cylindrical portion **312** and the barrel portion **212** rotate relative to each other. The groove width of the peripheral groove **315***b* is set to be slightly greater than the outer diameter of the connection pin **214** so as to allow the connection pin **214** to smoothly move. The groove

width of an end **315***f* (see FIG. **5**) of the peripheral groove **315***b* is modified so as to allow the connection pin **214** that is moved to come into close contact with an arc surface of the end.

In the case of this embodiment, as illustrated in FIG. **5**, a connection wall **315***c* is provided on the outside in the radial direction of the axial groove **315***a*. The connection wall **315***c* straddles the upper side of the axial groove **315***a* and is connected to the wall portions on both sides of the peripheral groove **315***b* to strengthen the periphery of the peripheral groove **315***b*.

As illustrated in FIG. **5**, the locking spring piece (locking portion in the present invention) **316** includes a spring piece **316***a* which is formed integrally with the cylindrical portion **312** to extend along the peripheral groove **315***b*, and a locking protrusion **316***b* which is formed integrally with the spring piece **316***a* to protrude toward the inside of the peripheral groove **315***b*. In the case of this embodiment, the spring piece **316***a* has a plate spring shape that is bent in an approximately V shape, and the V-shaped bent portion functions as the locking protrusion **316***b*.

As illustrated in FIG. **9**, when the connection pin **214** reaches the end **315***f* of the peripheral groove **315***b*, in the locking spring piece **316**, the locking protrusion **316***b* elastically comes into contact with the connection pin **214** from the start side of the peripheral groove **315***b* and restricts the movement of the connection pin **214** in a return direction (arrow R**1** direction of FIG. **9**).

In addition, as illustrated in FIG. **9**, in the locking spring piece **316** of this embodiment, in a case where the locking protrusion **316***b* receives a pressing force F**1** of a predetermined magnitude or higher in a direction toward the start side of the peripheral groove **315***b* from the connection pin **214** positioned at the end **315***f* of the peripheral groove **315***b*, the locking protrusion **316***b* retreats from the peripheral groove **315***b* and allows the movement of the connection pin **214** toward the start side of the peripheral groove **315***b*. That is, in the case of this embodiment, when a rotating operation force is applied to the second housing body **31** or the first housing body **21** so as to cause the connection pin **214** to return to the start side of the peripheral groove **315***b* in a state where joining of the second housing body **31** and the first housing body **21** is locked, if the rotating operation force reaches a predetermined magnitude or higher, the locking spring piece **316** retreats toward the outside of the peripheral groove **315***b* so as to enable the connection pin **214** to move toward the start side of the peripheral groove **315***b*.

As illustrated in FIG. **3**, the intermediate cylindrical portion **313** in the second housing body **31** is a cylindrical portion which accommodates the tip end side cylindrical portion **211** of the first housing body **21**. The inner diameter of the intermediate cylindrical portion **313** is set so as to allow the packing **23** to be interposed between the intermediate cylindrical portion **313** and the tip end side cylindrical portion **211**. The inner periphery of the packing **23** that is interposed between the intermediate cylindrical portion **313** and the tip end side cylindrical portion **211** comes into close contact with the tip end side cylindrical portion **211** and the outer periphery thereof comes into close contact with the intermediate cylindrical portion **313** such that the fitted portion of the first housing body **21** and the second housing body **31** is water-tightly sealed.

As illustrated in FIG. **3**, the inner diameter of the base end cylindrical portion **314** in the second housing body **31** is set to be smaller than that of the intermediate cylindrical portion **313**. The base end cylindrical portion **314** accommodates the second terminal fitting **60** and allows the front holder **32** which regulates the axial position of the second terminal fitting **60** to be fitted and attached to the base end cylindrical portion **314**. The base end cylindrical portion **314** fixes and supports the second terminal fitting **60** on the center axis C**2** of the second housing body **31** via the front holder **32**. In addition, the base end cylindrical portion **314** supports the second terminal fitting **60** so that the tip end portion of the second terminal fitting **60** is exposed from the front end of the second housing body **31**.

As illustrated in FIG. **3**, locking protrusions **314***a* for locking the rear holder **35** protrude from the outer periphery of the base end of the base end cylindrical portion **314**. The locking protrusions **314***a* are provided at two points of the outer periphery of the base end cylindrical portion **314**.

As illustrated in FIG. **3**, the second rubber stopper **34** is fitted and attached to the inner periphery of the base end of the base end cylindrical portion **314**. A portion of the base end cylindrical portion **314** to which the second rubber stopper **34** is attached is provided with a stepped portion **314***b* which has a greater diameter than the inner diameter of the front holder **32** side and abuts the outer peripheral edge of the second rubber stopper **34**.

The second rubber stopper **34** of this embodiment water-tightly seals a gap between the outer periphery of an electric wire **72** which is drawn from the base end side of the second housing body **31** toward the outside and the inner peripheral portion of the base end side of the second housing body **31**.

As illustrated in FIG. **4**, the rear holder **35** includes a disk portion **351** which covers the opening of the base end cylindrical portion **314**, and a cylindrical portion **352** which extends from the outer periphery of the disk portion **351** and is fitted to the outer periphery of the base end cylindrical portion **314**. The center of the disk portion **351** is provided with an electric wire insertion hole **353** through which the electric wire **72** is inserted. Engagement holes **354** which are engaged with the locking protrusions **314***a* on the base end cylindrical portion **314** are formed in the cylindrical portion **352**. The cylindrical portion **352** is provided with slits **355** on both sides of the engagement hole **354**. The slit **355** allows a portion having the engagement hole **354** to be easily elastically deformed. As illustrated in FIG. **3**, the rear holder **35** mounted on the base end cylindrical portion **314** presses the second rubber stopper **34** attached to the inner periphery of the base end cylindrical portion **314** against the stepped portion **313***b* so as to fix the second rubber stopper **34**.

Next, a procedure of fitting and connecting the first connector housing **20** and the second connector housing **30** to each other in the rotary connector **10** of the first embodiment described above will be described with reference to FIGS. **5** to **10**.

First, as illustrated in FIGS. **5** and **6**, the first connector housing **20** and the second connector housing **30** are in a state of facing each other so that the positions of a plurality of connection pins **214** of the barrel portion **212** of the first housing body **21** are aligned with the positions of a plurality of axial grooves **315***a* of the cylindrical portion **312** of the second housing body **31**. Thereafter, as indicated by arrow X**1** in FIG. **6**, the second housing body **31** and the first housing body **21** are allowed to abut each other along the direction of the center axis O**3** of the cylindrical portion **312** of the second housing body **31** such that a fitted state illustrated in FIGS. **7** and **8** is obtained. The fitted state illustrated in FIGS. **7** and **8** is a state in which each of the connection pins **214** reaches the end of the corresponding axial groove **315***a*.

Next, when the housing bodies **21** and **31** are rotated relative to each other to allow the connection pins **214** on the first housing body **21** to intrude into the respective peripheral grooves **315***b* on the second housing body **31**, the relative movement of the housing bodies **21** and **31** in the axial direction is restricted and thus the connector housings **20** and **30** enter a joined state.

When the housing bodies **21** and **31** are further rotated relative to each other until each of the connection pins **214** reaches the end **315***f* of the corresponding peripheral groove **315***b*, as illustrated in FIGS. **9** and **10**, the locking protrusion **316***b* of the locking spring piece **316** elastically comes into contact with the connection pin **214** from the start side of the peripheral groove **315***b* and restricts the movement of the connection pin **214** in the return direction, such that the joined state of the connector housings **20** and **30** is locked.

In addition, in the rotary connector **10** of this embodiment, as illustrated in FIGS. **9** and **10**, in a state where the joined state of the housing bodies **21** and **31** is locked, a rotating operation force is applied to the housing bodies in the direction opposite to that during the locked state so as to allow the connection pin **214** to apply a pressing force of a predetermined magnitude or higher to the locking protrusion **316***b* of the locking spring piece **316** in a direction toward the start side of the peripheral groove **315***b*, the locking protrusion **316***b* retreats from the peripheral groove **315***b* and enters a lock released state, thereby enabling the connection pin **214** to move toward the start side of the peripheral groove **315***b*.

Therefore, after the housing bodies are rotated until the connection pin **214** reaches the start of the peripheral groove **315***b* (that is, the end of the axial groove **315***a*), the housing bodies are separated from each other in the axial direction, thereby allowing the connector housings **20** and **30** to be in a state of being separated from each other.

That is, in the rotary connector **10** of this embodiment, without using a tool, the connector housings **20** and **30** can be simply attached to and detached from each other only by a moving operation in the axial direction and a rotating operation in the peripheral direction.

In addition, when the housing bodies **21** and **31** are in the fitted state illustrated in FIGS. **7** and **8**, in the first terminal fitting **50** and the second terminal fitting **60** which are respectively fixed and supported by the housing bodies **21** and **31**, as illustrated in FIGS. **13** and **14**, which will be described later, the tip end portions thereof abut each other in a state where a contact spring piece **53** provided in the first terminal fitting **50** is inserted into a contact release portion **64** provided in the second terminal fitting **60**.

In addition, when the housing bodies **21** and **31** are in the locked state illustrated in FIGS. **9** and **10**, in the first terminal fitting **50** and the second terminal fitting **60** which are respectively fixed and supported by the housing bodies **21** and **31**, as illustrated in FIGS. **15** and **16**, which will be described later, the contact spring piece **53** provided in the first terminal fitting **50** rides on a contact surface **63** provided in the second terminal fitting **60** such that the first terminal fitting **50** and the second terminal fitting **60** enter a state of being electrically connected to each other.

Description of Terminal Fitting Connection Structure of First Embodiment

FIGS. **11** to **16** illustrate the terminal fitting connection structure of the first embodiment. FIG. **11** is an enlarged view of the first terminal fitting illustrated in FIG. **4**, FIG. **12** is an enlarged view of the second terminal fitting illustrated in FIG. **4**, FIG. **13** is a side view of a state in which the first terminal fitting and the second terminal fitting abut each other in the first embodiment, FIG. **14** is a view viewed from arrow G of FIG. **13**, and FIG. **15** is an explanatory view of a state in which the second terminal fitting is rotated relative to the first terminal fitting by a predetermined angle in arrow R**3** direction from the state of FIG. **14** and a contact protrusion of the first terminal fitting rides on the contact surface of the second terminal fitting.

In the terminal fitting connection structure of the first embodiment, the contact spring piece **53** provided in the first terminal fitting **50** comes into pressing contact with the contact surface **63** provided in the second terminal fitting **60** such that the first terminal fitting **50** and the second terminal fitting **60** enter a state of being electrically connected to each other.

The first terminal fitting **50** is an abutting type terminal fitting in which the tip end thereof is allowed to abut the tip end of a mated terminal fitting and is thus electrically connected to the mated terminal fitting. The first terminal fitting **50** is a press-formed product of a metal plate and as illustrated in FIG. **13**, includes a first terminal body **51**, a first annular portion **52**, and a plurality of contact spring pieces **53**.

As illustrated in FIG. **13**, the first terminal body **51** extends on a center axis M**1** of the first terminal fitting **50**. The base end of the first terminal body **51** (in FIG. **13**, right end) is provided with a wire caulking piece **51***a*. By the wire caulking piece **51** a, the electric wire **71** is clamped and connected to the base end of the first terminal body **51** substantially coaxially with the center axis M**1** of the first terminal fitting **50**.

The first annular portion **52** is formed at the tip end of the first terminal body **51** (in FIG. **13**, left end) in an annular shape concentrically with the center axis M**1** of the first terminal fitting **50**.

As illustrated in FIG. **14**, the contact spring pieces **53** are provided at a plurality of points arranged on the outer periphery of the first annular portion **52** at predetermined intervals in the peripheral direction of the first annular portion **52**. As illustrated in FIG. **14**, the contact spring pieces **53** includes a spring support portion **531** which extends outward in the radial direction of the first annular portion **52** from the outer periphery of the first annular portion **52**, an elastic piece **532** which extends from the spring support portion **531** along the outer periphery of the first annular portion **52**, and a contact protrusion **533** which protrudes from the elastic piece **532**.

In addition, the first annular portion **52** may have an annular portion provided with the contact spring pieces **53**, and may also be hollow or solid.

The tip end side of the elastic piece **532** can be displaced in the direction of the center axis M**1** of the first terminal fitting **50**.

As illustrated in FIG. **13**, the contact protrusion **533** protrudes from the elastic piece **532** in a state of protruding further toward a mated terminal side than the tip end of the first annular portion **52**.

The second terminal fitting **60** is an abutting type terminal fitting in which the tip end thereof is allowed to abut the tip end of the first terminal fitting **50** and is thus electrically connected to the first terminal fitting **50**. The second terminal fitting **60** is a press-formed product of a metal plate and as illustrated in FIG. **13**, includes a second terminal body **61**, a second annular portion **62**, a plurality of contact surfaces **63**, and a plurality of contact release portions **64**.

As illustrated in FIG. **13**, the second terminal body **61** extends on a center axis M2 of the second terminal fitting **60**. The base end of the second terminal body **61** (in FIG. **13**, left end) is provided with a wire caulking piece **61***a*. By the wire caulking piece **61***a*, the electric wire **72** is clamped and connected to the base end of the second terminal body **61** substantially coaxially with the center axis M2 of the second terminal fitting **60**.

The second annular portion **62** has an annular shape with the same dimensions as those of the first annular portion **52** of the first terminal fitting **50**. The second annular portion **62** is provided at the tip end of the second terminal body **61** concentrically with the center axis M2 of the second terminal fitting **60**.

The contact surfaces **63** protrude outward in the radial direction of the second annular portion **62** from a plurality of points of the outer periphery of the second annular portion **62**. The plurality of contact surfaces **63** are arranged on the outer periphery of the second annular portion **62** at the same intervals as those of the plurality of contact protrusions **533** in the first terminal fitting **50**.

The second annular portion **62** may have an annular portion provided with the contact surfaces **63**, and may also be hollow or solid.

As illustrated in FIG. **12**, the contact release portions **64** are voids positioned between the adjacent contact surfaces **63**. Into the contact release portions **64**, the contact protrusions **533** can be inserted.

In the terminal fitting connection structure in this embodiment, the first terminal fitting **50** and the second terminal fitting **60** are allowed to face each other so as to enable the contact protrusions **533** of the plurality of contact spring pieces **53** of the first terminal fitting **50** and the plurality of contact release portions **64** of the second terminal fitting **60** to oppose each other. Next, as illustrated in FIGS. **13** and **14**, the first terminal fitting **50** and the second terminal fitting **60** are allowed to abut each other on the same axis so as to allow the plurality of contact protrusions **533** of the first terminal fitting **50** to be inserted into the plurality of contact release portions **64** of the second terminal fitting **60**. Thereafter, in the state in which the two terminal fittings abut each other, as illustrated in FIGS. **15** and **16**, when the first terminal fitting **50** and the second terminal fitting **60** are rotated relative to each other by a predetermined angle on the same axis, the contact protrusions **533** of the plurality of contact spring pieces **53** of the first terminal fitting **50** ride on the plurality of contact surfaces **63** of the second terminal fitting **60**. Accordingly, the contact protrusions **533** of the plurality of contact spring pieces **53** of the first terminal fitting **50** enter a state of coming into pressing contact with the plurality of contact surfaces **63** of the second terminal fitting **60**, and thus the first terminal fitting **50** and the second terminal fitting **60** enter the electrically connected state.

In addition, in the case of the terminal fitting connection structure of this embodiment, the contact spring pieces **53** extend in the peripheral direction of the first annular portion **52** at the tip end of the first terminal fitting **50**. That is, the contact spring piece **53** is configured to extend in an arc shape on a plane perpendicular to the axial direction of the first terminal fitting **50**. Therefore, even when a sufficient length for the contact spring piece **53** is ensured in order to ensure stable flexibility for the contact spring piece **53**, the dimensions of the terminal fittings in the axial direction are not affected.

Therefore, even in a case where a necessary and sufficient length for the contact spring piece **53** is ensured, the axial length of the terminal fittings is reduced, resulting in a reduction in the size of the terminal fittings. In addition, due to a reduction in the size of the terminal fittings, a reduction in the size of a connector that accommodates the terminal fittings can be achieved.

In addition, according to the terminal fitting connection structure in this embodiment, the electrical connection between the first terminal fitting **50** and the second terminal fitting **60** is achieved by contact between the plurality of contact protrusions **533** and the plurality of contact surfaces **63**, and thus the total contact area of the contact portions of the terminal fittings is increased. Therefore, the conductor resistance in the contact portions is decreased, and thus the reliability of the electrical connection can be enhanced.

In addition, in the case of the rotary connector **10** in this embodiment, the axial lengths of the first terminal fitting **50** and the second terminal fitting **60**, which are respectively accommodated in the connector housings **20** and **30**, can be reduced as described above. Therefore, as the axial lengths of the terminal fittings **50** and **60** are reduced, the axial lengths of the connector housings **20** and **30** can also be reduced. Accordingly, a reduction in the size of the rotary connector **10** is achieved, and thus a mountable ability thereof in a vehicle that is difficult to ensure a sufficient installation space can be enhanced.

In addition, in the case of the rotary connector **10** in this embodiment, as illustrated in FIG. **3**, the terminal fittings **50** and **60** which are respectively accommodated in the connector housings **20** and **30** are respectively fixed on the center axes C1 and C2 of the connector housings **20** and **30**. Therefore, the axial movement of the connector housings **20** and **30** and the rotating operation of the connector housings **20** and **30** around the center axes C1 and C2 become the axial movement and the rotating operation of the terminal fittings **50** and **60** which are respectively accommodated in the connector housings **20** and **30**.

On the other hand, moving two in an axial direction from a state in which the two face each other on the same axis so as to allow the two to abut each other, and then rotating the two that abut each other relative to each other by a predetermined angle are common to both a necessary operation for joining the connector housings **20** and **30** included in the rotary connector **10** and a necessary operation for electrically connecting the terminal fittings **50** and **60** to each other.

Therefore, by allowing a necessary relative rotation angle for a transition of the connector housings **20** and **30** from the abutting state to a lock completed state to be the same as a necessary relative rotation angle for a transition from an abutting state in which the contact protrusions **533** of the first terminal fitting **50** are inserted into the contact release portions **64** of the second terminal fitting **60** to the electrically connected state in which the contact protrusions **533** of the first terminal fitting **50** ride on the contact surfaces **63** of the second terminal fitting **60**, when the joining of the connector housings **20** and **30** is locked, the terminal fittings **50** and **60** which are respectively accommodated in the connector housings **20** and **30** simultaneously can be allowed to enter the electrically connected state.

Description of Terminal Fitting Connection Structure of Second Embodiment

FIGS. **17** to **22** illustrate a terminal fitting connection structure of a second embodiment. FIG. **17** is a perspective view of a second embodiment of the second terminal fitting according to the present invention, FIG. **18** is a side view of a state in which the second terminal fitting illustrated in FIG. **17** and the first terminal fitting illustrated in FIG. **11** abut

each other, FIG. **19** is a view viewed from arrow H of FIG. **18**, and FIG. **20** is an explanatory view of a state in which the second terminal fitting is rotated relative to the first terminal fitting by a predetermined angle in arrow R**4** direction from the state of FIG. **19** and the contact protrusion of the first terminal fitting rides on a contact surface of the second terminal fitting. In addition, FIG. **21** is a partial sectional view taken along line I-I of FIG. **20**, and FIG. **22** is a perspective view of the first terminal fitting and the second terminal fitting in a connected state illustrated in FIG. **20**.

In the terminal fitting connection structure of the second embodiment, a second terminal fitting **60**A is used instead of the second terminal fitting **60** of the first embodiment.

The second terminal fitting **60**A is provided with recessed portions **65** in the plurality of contact surfaces **63** that protrude outward in the radial direction from the outer periphery of the second annular portion **62**. The recessed portion **65** is a dent to which the contact protrusion **533** of the first terminal fitting **50** that rides on the contact surface **63** is fitted. The recessed portion **65** restricts the movement of the contact protrusion **533** as the contact protrusion **533** is fitted to the recessed portion **65**.

The configuration of the second terminal fitting **60** of the first embodiment is common to that of the second terminal fitting **60**A of the second embodiment except that the recessed portions **65** are respectively provided in the contact surfaces **63**. Like elements that are common to the second terminal fitting **60** of the first embodiment are denoted by like reference numerals, and descriptions thereof will not be repeated.

In the case of the terminal fitting connection structure of the second embodiment, as illustrated in FIG. **21**, the contact protrusion **533** that rides on the contact surface **63** is fitted to the recessed portion **65** provided in the contact surface **63** such that the recessed portion **65** restricts the movement of the contact protrusion **533**.

Therefore, slipping of the contact protrusion **533** on the contact surface **63** due to external vibration transmitted from the electric wires **71** and **72** and the like connected to the terminal fittings **50** and **60**A can be prevented. As a result, the occurrence of problems such as wear or a reduction in contact pressure caused by the slipping of the contact protrusion **533** on the contact surface **63** can be prevented.

Description of Terminal Fitting Connection Structure of Third Embodiment

FIGS. **23** to **26**C illustrate a terminal fitting connection structure of a third embodiment. FIG. **23** is a perspective view of a third embodiment of the second terminal fitting according to the present invention, and FIG. **24** is a side view of a state in which the second terminal fitting illustrated in FIG. **23** and the first terminal fitting illustrated in FIG. **11** abut each other. FIGS. **25**A to **25**D are explanatory views of a transition of the connected state during relative rotation between the second terminal fitting of the third embodiment and the first terminal fitting. FIG. **25**A is an explanatory view of the connected state in an initial abutting state of the terminal fittings, FIG. **25**B is an explanatory view of the connected state in a first stage transited from FIG. **25**A by predetermined relative rotation, FIG. **25**C is an explanatory view of the connected state in a second stage transited from FIG. **25**B by predetermined relative rotation, and FIG. **25**D is an explanatory view of a connection completed state transited from FIG. **25**C by predetermined relative rotation. In addition, FIGS. **26**A to **26**C are explanatory views of three modes of the connected state of the contact protrusion and the corresponding contact surface illustrated in FIGS. **25**A to **25**D.

In the terminal fitting connection structure of the third embodiment, a second terminal fitting **60**B is used instead of the second terminal fitting **60** of the first embodiment.

The second terminal fitting **60**B is provided with an inclined surface **66** at one edge of each of the plurality of contact surfaces **63** that protrude outward in the radial direction from the outer periphery of the second annular portion **62**. The inclined surface **66** is a guide surface which guides the contact protrusion **533** which is inserted into the contact release portion **64** onto the contact surface **63**. The inclined surface **66** of this embodiment is provided in one side edge of the contact surface **63** which faces the contact release portion **64**.

Furthermore, in the second terminal fitting **60**B of the third embodiment, the arrangement of the contact surfaces **63** is set so that portions of the plurality of contact protrusions **533** provided in the first terminal fitting **50** ride on the contact surfaces **63** of the second terminal fitting **60**B at timings delayed from those of the other contact protrusions **533**.

Specifically, for example, the arrangement of each of the contact surfaces **63** is adjusted so that the contact protrusions **533** that are provided at symmetrical positions with respect to the center axis of the first terminal fitting **50** simultaneously ride on the contact surfaces **63** of the second terminal fitting **60**B while the other contact protrusions **533** thereafter ride on the contact surfaces **63** at delayed timings.

The configuration of the second terminal fitting **60** of the first embodiment is common to that of the second terminal fitting **60**B of the third embodiment except two points that the inclined surface **66** is provided at one edge of the contact surface **63** and that the arrangement of the contact surfaces **63** is set so as to allow not all the plurality of contact protrusions **533** provided in the first terminal fitting **50** to ride on the contact surfaces **63** at the same timing. Like elements that are common to the second terminal fitting **60** of the first embodiment are denoted by like reference numerals, and descriptions thereof will not be repeated.

In the case of the terminal fitting connection structure of the third embodiment, when the contact protrusions **533** of the first terminal fitting **50** that are inserted into the contact release portions **64** of the second terminal fitting **60**B ride on the contact surfaces **63** of the second terminal fitting **60**B by the relative rotation between the first terminal fitting **50** and the second terminal fitting **60**B, since the contact protrusions **533** move on the inclined surface **66** connected to the contact surface **63**, the contact protrusion **533** does not abruptly collide with the edge of the contact surface **63**. Furthermore, the bending deformation amount of the contact spring piece **53** which occurs when the contact protrusion **533** rides on the contact surface **63** is gradually changed.

Therefore, the rotating operation force for the contact protrusion **533** of the first terminal fitting **50** to ride on the contact surface **63** of the second terminal fitting **60**B can be reduced, and the operability during the rotating operation can be enhanced.

In addition, in the case of the terminal fitting connection structure of the third embodiment, when a connection completed state in which all of the contact protrusions **533** of the first terminal fitting **50** respectively ride on the contact surfaces **63** of the second terminal fitting **60**B is achieved from a non-connection state in which all of the contact protrusions **533** of the first terminal fitting **50** are respec-

tively inserted into the contact release portions **64** of the second terminal fitting **60**B, as illustrated in FIGS. **25**A to **25**D, the riding of the contact protrusions **533** on the contact surfaces **63** proceeds in stages.

FIG. **25**A illustrates the initial abutting state of the terminal fittings, in which all of the contact protrusions **533** are separated from the inclined surfaces **66** and the contact surfaces **63** as illustrated in FIG. **26**A in the non-connection state.

FIG. **25**B illustrates a state in which the relative rotation between the terminal fittings proceeds from FIG. **25**A. In this state, a portion of the contact protrusion **533** rides on the inclined surface **66** but does not reach the contact surface **63** as illustrated in FIG. **26**B. In addition, the connection mode illustrated in FIG. **26**A is also present.

FIG. **25**C illustrates a state in which the relative rotation between the terminal fittings further proceeds from FIG. **25**B. In this state, the portion of the contact protrusion **533** rides on the contact surface **63** as illustrated in FIG. **26**C and enters the electrically connected state. However, the connection mode illustrated in FIG. **26**B and the connection mode illustrated in FIG. **26**A are also present.

FIG. **25**D illustrates a state in which the relative rotation between the terminal fittings further proceeds from FIG. **25**C and the relative rotation is completed. In this state, all of the contact protrusions **533** ride on the contact surfaces **63** and enter the electrically connected state as illustrated in FIG. **26**C.

That is, in the terminal fitting connection structure of the third embodiment, as illustrated in FIGS. **25**A to **26**C, the operation of causing the contact protrusions **533** of the first terminal fitting **50** to ride on the contact surfaces **63** of the second terminal fitting **60**B proceeds in a plurality of stages at delayed timings.

Therefore, compared to the case in which all of the plurality of contact protrusions **533** provided in the first terminal fitting **50** simultaneously ride on the corresponding contact surfaces **63** of the second terminal fitting **60**B, as the number of contact protrusions **533** that simultaneously ride on the contact surfaces **63** is reduced, the rotating operation force applied between the two terminal fittings is reduced, and thus the operability can be enhanced.

Description of Terminal Fitting Connection Structure of Fourth Embodiment

FIGS. **27** and **28** illustrate a terminal fitting connection structure of a fourth embodiment. FIG. **27** is a perspective view of a fourth embodiment of the second terminal fitting according to the present invention, and FIG. **28** is a perspective view of a state in which the second terminal fitting illustrated in FIG. **27** and the first terminal fitting illustrated in FIG. **11** abut each other.

In the terminal fitting connection structure of the fourth embodiment, a second terminal fitting **60**C is used instead of the second terminal fitting **60** of the first embodiment.

The second terminal fitting **60**C is made by adding the recessed portion **65** to the contact surface **63** in the second terminal fitting **60**B of the third embodiment. The recessed portion **65** is the same as that provided in the contact surface **63** in the second terminal fitting **60**A of the second embodiment. That is, the recessed portion **65** restricts the movement of the contact protrusion **533** as the contact protrusion **533** that rides on the contact surface **63** is fitted to the recessed portion **65**.

The configuration of the second terminal fitting **60**B of the third embodiment is common to that of the second terminal fitting **60**C of the fourth embodiment except that the recessed portions **65** are provided in the contact surfaces **63**. Like elements that are common to the third embodiment are denoted by like reference numerals, and descriptions thereof will not be repeated.

In the case of the terminal fitting connection structure of the fourth embodiment, the following actions and effects can be obtained in addition to the actions and effects in the terminal fitting connection structure of the third embodiment.

That is, as illustrated in FIG. **28**, the contact protrusion **533** that rides on the contact surface **63** is fitted to the recessed portion **65** provided in the contact surface **63** such that the recessed portion **65** restricts the movement of the contact protrusion **533**.

Therefore, slipping of the contact protrusion **533** on the contact surface **63** due to external vibration transmitted from the electric wires **71** and **72** and the like connected to the terminal fittings **50** and **60**C can be prevented. As a result, the occurrence of problems such as wear or a reduction in contact pressure caused by the slipping of the contact protrusion **533** on the contact surface **63** can be prevented.

The present invention is not limited to the above-described embodiments, and appropriate modifications, improvements, and the like can be made. In addition, the materials, shapes, dimensions, numbers, arrangement points, and the like of the constituent elements in the above-described embodiments are arbitrary and are not limited as long as the present invention can be accomplished.

For example, in the embodiments, the effect that the arrangement of the contact surfaces **63** in the second terminal fitting is designed to prevent all of the contact protrusions provided in the first terminal fitting from riding on the corresponding contact surfaces of the second terminal fitting at the same timing is described. However, the riding timings may also be delayed by designing the arrangement of the contact protrusions in the first terminal fitting.

In addition, in the embodiments, a configuration in which the connection pins **214** are provided in the first housing body **21** and the axial grooves **315***a*, the peripheral grooves **315***b*, and the locking spring pieces **316** are provided in the second housing body **31** is employed. However, a configuration in which the connection pins **214** are provided in the second housing body **31** and the axial grooves **315***a*, the peripheral grooves **315***b*, and the locking spring pieces **316** are provided in the first housing body **21** may also be employed. In this case, the connection pins **214** provided in the second housing body **31** are provided to protrude inward in the radial direction.

In addition, in the embodiments, a configuration in which the plurality of connection pins **214** and the plurality of locking spring pieces **316** are respectively provided in the housing bodies **21** and **31** is employed. However, only a single connection pin **214** and only a single locking spring piece **316** may also be respectively provided in the housing bodies **21** and **31**.

In addition, the locking portion **316** may not be constituted by the spring piece **316***a* and the locking protrusion **316***b* unlike the embodiments, and may also be constituted only by the locking protrusion **316***b* that extends toward the peripheral groove **315***b* without a thinning portion and the spring piece **316***a*. In this case, the connection pin **214** can pass through a portion in the peripheral groove **315***b* narrowed by the locking protrusion **316***b* in a state of coming into pressing contact with the portion.

Here, the features of the embodiments of the terminal fitting connection structure and the rotary fitting type connector according to the present invention described above will be concisely listed in the following [1] to [6].

[1] A terminal fitting connection structure which presses contact spring pieces (**53**) provided in a first terminal fitting (**50**) to contact surfaces (**63**) provided in a second terminal fitting (**60**) so as to contact thereto, so that the first terminal fitting (**50**) and the second terminal fitting (**60**) to enter a state of being electrically connected to each other, in which

the first terminal fitting (**50**) includes a first terminal body (**51**) which extends on a center axis (M**1**) of the first terminal fitting (**50**) and has a base end to which an electric wire (**71**) is connected substantially coaxially with the center axis (M**1**) of the first terminal fitting (**50**), a first annular portion (**52**) which is formed at a tip end of the first terminal body (**51**) in an annular shape concentrically with the center axis (M**1**) of the first terminal fitting (**50**), and a plurality of the contact spring pieces (**53**) which are provided at a plurality of points arranged on an outer periphery of the first annular portion (**52**) at predetermined intervals in a peripheral direction of the first annular portion (**52**),

the contact spring piece (**53**) includes a spring support portion (**531**) which extends outward in a radial direction of the first annular portion (**52**) from the outer periphery of the first annular portion (**52**), an elastic piece (**532**) which extends from the spring support portion (**531**) along the outer periphery of the first annular portion (**52**) and has a tip end side that is displaceable in a direction of the center axis (M**1**) of the first terminal fitting (**50**), and a contact protrusion (**533**) which protrudes from the elastic piece (**532**) so as to protrude further toward a mated terminal side than a tip end of the first annular portion (**52**), and

the second terminal fitting (**60**) includes a second terminal body (**61**) which extends on a center axis (M**2**) of the second terminal fitting (**60**) and has a base end to which an electric wire (**72**) is connected substantially coaxially with the center axis (M**2**) of the second terminal fitting (**60**), a second annular portion (**62**) which is provided at a tip end of the second terminal body (**61**) in the same annular shape as that of the first annular portion (**52**) of the first terminal fitting (**50**) concentrically with the center axis (M**2**) of the second terminal fitting (**60**), a plurality of the contact surfaces (**63**) which protrude outward in a radial direction of the second annular portion (**62**) from an outer periphery of the second annular portion (**62**) at the same intervals as those of the plurality of the contact protrusions (**533**) in the first terminal fitting (**50**), and a plurality of contact release portions (**64**) which are positioned between the adjacent contact surfaces (**63**) and allow the contact protrusions (**533**) to be inserted into the contact release portions (**64**).

[2] The terminal fitting connection structure described in [1], in which the plurality of the contact surfaces (**63**) of the second terminal fitting (**60**) are provided with recessed portions (**65**) to which the contact protrusions (**533**) that ride on the contact surfaces (**63**) are fitted.

[3] The terminal fitting connection structure described in [1] or [2], in which one side edge of each of the plurality of the contact surfaces (**63**) of the second terminal fitting (**60**), which faces the contact release portion (**64**), is provided with an inclined surface (**66**) which guides the contact protrusion (**533**) that is inserted into the contact release portion (**64**) onto the contact surface (**63**).

[4] The terminal fitting connection structure described in any one of [1] to [3], in which an arrangement of the contact protrusions (**533**) and the contact surfaces (**63**) is set so that portions of the plurality of the contact protrusions (**533**) provided in the first terminal fitting (**50**) ride on the contact surfaces (**63**) of the second terminal fitting (**60**) at timings different from those of the other contact protrusions (**533**).

[5] A rotary connector (**10**) which allows terminal fittings to enter a state of being electrically connected to each other by using the terminal fitting connection structure described in any one of [1] to [4], the rotary connector comprising:

a first connector housing (**20**) which includes

a first housing body (**21**) which fixes and supports the first terminal fitting (**50**) on a center axis (C**1**) so as to expose a tip end portion of the first terminal fitting (**50**) that is fixed and supported from a front end of the first housing body (**21**), and has a circular section that is concentric with the center axis (C**1**), and

a connection pin (**214**) which protrudes from the first housing body (**21**) along a radial direction thereof; and

a second connector housing (**30**) which includes

a second housing body (**31**) which fixes and supports the second terminal fitting (**60**) on the center axis (C**1**) so as to expose a tip end portion of the second terminal fitting (**60**) that is fixed and supported from a front end of the second housing body (**31**), has a circular section that is concentric with the center axis (C**1**), and is fitted to the first housing body (**21**),

an axial groove (**315***a*) which is cut out from an end portion of the second housing body (**31**) on the first connector housing (**20**) side so as to extend along a center axis direction of the second housing body (**31**), and allows the connection pin (**214**) to be inserted into the axial groove (**315***a*) when the first housing body (**21**) is fitted to the second housing body (**31**) along the center axis direction of the second housing body (**31**),

a peripheral groove (**315***b*) which extends from an end of the axial groove (**315***a*) toward one side in a peripheral direction of the second housing body (**31**) along the peripheral direction to have a predetermined length, and allows the connection pin (**214**) to move in the peripheral groove (**315***b*) when the first housing body (**21**) and the second housing body (**31**) are rotated relative to each other, and

a locking portion (**316**) which comes into contact with the connection pin (**214**) from a start side of the peripheral groove (**315***b*) when the connection pin (**214**) reaches an end of the peripheral groove (**315***b*) and restricts movement of the connection pin (**214**) in a return direction, thereby locking a joined state of the connector housings.

[6] A rotary connector (**10**) which allows terminal fittings to enter a state of being electrically connected to each other by using the terminal fitting connection structure described in any one of [1] to [4], including:

a first connector housing (**20**) which includes

a first housing body (**21**) which fixes and supports the first terminal fitting (**50**) on a center axis (C**1**) to allow a tip end portion of the first terminal fitting (**50**) that is fixed and supported, to be exposed from a front end of the first housing body (**21**),

a barrel portion (**212**) which is formed on an outer periphery of the first housing body (**21**) and has a circular outer periphery that is concentric with the center axis (C**1**) of the first housing body (**21**), and

a connection pin (**214**) which protrudes outward in a radial direction from the outer periphery of the barrel portion (**212**); and

a second connector housing (**30**) which includes

a second housing body (**31**) which fixes and supports the second terminal fitting (**60**) on a center axis (C**2**) to allow a tip end portion of the second terminal fitting

(60) that is fixed and supported, to be exposed from a front end of the second housing body (31),

a cylindrical portion (312) which protrudes toward a front end portion of the second housing body (31) in a cylindrical shape that is concentric with the center axis (C2) of the second housing body (31), and is fitted to the barrel portion (212) of the first connector housing (20),

an axial groove (315*a*) which is formed to be cut out from an opening end of the cylindrical portion (312) so as to extend along a direction of a center axis (O3) of the cylindrical portion (312), and allows the connection pin (214) to be inserted into the axial groove (315*a*) when the barrel portion (212) is fitted to the cylindrical portion (312) along the direction of the center axis (O3) of the cylindrical portion (312),

a peripheral groove (315*b*) which extends from an end of the axial groove (315*a*) toward one side in a peripheral direction of the cylindrical portion (312) along the peripheral direction to have a predetermined length, and allows the connection pin (214) to move in the peripheral groove (315*b*) when the cylindrical portion (312) and the barrel portion (212) are rotated relative to each other, and

a locking spring piece (316) which elastically comes into contact with the connection pin (214) from a start side of the peripheral groove (315*b*) when the connection pin (214) reaches an end of the peripheral groove (315*b*) and restricts movement of the connection pin (214) in a return direction, thereby locking a joined state of the connector housings.

While the present invention has been described in detail with reference to the specific embodiments, it should be noted by those skilled in the art that various changes and modifications can be added without departing from the spirit and scope of the present invention.

According to the terminal fitting connection structure in the present invention, a reduction in the size of a connector which accommodates terminal fittings can be achieved by reducing the axial length of the terminal fittings, and the reliability of electrical connection can be enhanced by reducing the conductor resistance in contact portions of the terminal fittings. The present invention that exhibits this effect is useful in a terminal fitting connection structure, and a rotary fitting type connector which electrically connects terminal fittings to each other using the terminal fitting connection structure.

What is claimed is:

1. A terminal fitting connection structure which presses contact spring pieces provided in a first terminal fitting to contact surfaces provided in a second terminal fitting so as to contact thereto, so that the first terminal fitting and the second terminal fitting are electrically connected to each other, wherein

the first terminal fitting includes:

a first terminal body which extends on a center axis of the first terminal fitting and has a base end to which an electric wire is connected substantially coaxially with the center axis of the first terminal fitting,

a first annular portion which is formed at a tip end of the first terminal body in an annular shape concentrically with the center axis of the first terminal fitting, and

a plurality of the contact spring pieces which are provided at a plurality of points arranged on an outer periphery of the first annular portion at predetermined intervals in a peripheral direction of the first annular portion,

the contact spring piece includes:

a spring support portion which extends outward in a radial direction of the first annular portion from the outer periphery of the first annular portion,

an elastic piece which extends from the spring support portion along the outer periphery of the first annular portion and has a tip end side that is displaceable in a direction of the center axis of the first terminal fitting, and

a contact protrusion which protrudes from the elastic piece so as to protrude further toward a mated terminal side than a tip end of the first annular portion, and

the second terminal fitting includes:

a second terminal body which extends on a center axis of the second terminal fitting and has a base end to which an electric wire is connected substantially coaxially with the center axis of the second terminal fitting,

a second annular portion which is provided at a tip end of the second terminal body in the same annular shape as that of the first annular portion of the first terminal fitting concentrically with the center axis of the second terminal fitting,

a plurality of the contact surfaces which protrude outward in a radial direction of the second annular portion from an outer periphery of the second annular portion at the same intervals as those of the plurality of the contact protrusions in the first terminal fitting, and

a plurality of contact release portions which are positioned between the adjacent contact surfaces and allow the contact protrusions to be inserted into the contact release portions.

2. The terminal fitting connection structure according claim **1**, wherein

the plurality of the contact surfaces of the second terminal fitting are provided with recessed portions to which the contact protrusions that ride on the contact surfaces are fitted.

3. The terminal fitting connection structure according to claim **1**, wherein

one side edge of each of the plurality of the contact surfaces of the second terminal fitting, which faces the contact release portion, is provided with an inclined surface which guides the contact protrusion that is inserted into the contact release portion onto the contact surface.

4. The terminal fitting connection structure according to claim **1**, wherein

an arrangement of the contact protrusions and the contact surfaces is set so that portions of the plurality of the contact protrusions provided in the first terminal fitting ride on the contact surfaces of the second terminal fitting at timings different from those of the other contact protrusions.

5. A rotary connector which allows terminal fittings to enter a state of being electrically connected to each other by using the terminal fitting connection structure according to claim **1**, the rotary connector comprising:

a first connector housing which includes

a first housing body which fixes and supports the first terminal fitting on a center axis so as to expose a tip end portion of the first terminal fitting that is fixed

and supported from a front end of the first housing body, and has a circular section that is concentric with the center axis, and

a connection pin which protrudes from the first housing body along a radial direction thereof; and

a second connector housing which includes

a second housing body which fixes and supports the second terminal fitting on the center axis so as to expose a tip end portion of the second terminal fitting that is fixed and supported from a front end of the second housing body, has a circular section that is concentric with the center axis, and is fitted to the first housing body,

an axial groove which is cut out from an end portion of the second housing body on the first connector housing side so as to extend along a center axis direction of the second housing body, and allows the connection pin to be inserted into the axial groove when the first housing body is fitted to the second housing body along the center axis direction of the second housing body,

a peripheral groove which extends from an end of the axial groove toward one side in a peripheral direction of the second housing body along the peripheral direction to have a predetermined length, and allows the connection pin to move in the peripheral groove when the first housing body and the second housing body are rotated relative to each other, and

a locking portion which comes into contact with the connection pin from a start side of the peripheral groove when the connection pin reaches an end of the peripheral groove and restricts movement of the connection pin in a return direction, thereby locking a joined state of the connector housings.

* * * * *